ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXI, No. 22.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....441, 457
Gas for Fuel..... 442
Railway Switching and Yards (illustrated)..... 442
Public Latrines in London (illustrated)..... 445
Present and Proposed Water Supply, Saginaw, Mich. 445
Specifications for Steel for Railway Bridges..... 446
Asphalt Pavement, Muncie, Ind. (illustrated)..... 446
Intercepting Valve for Compound Locomotives (illustrated) 447
The Niagara Falls Power Plant..... 447
Legal Decisions..... 447
The Hyde Park Tunnel, Chicago Water-Works (with Inset)..... 452
A Concrete Sewer on Piles..... 454
Tests of 18-in. Armor Plate (illustrated)..... 454
Notes on Track Improvement..... 454
Testing the Commercial Value of Steam Coals.... 454
Statistics of Mineral Production in the United States 455
Pumping Water for Irrigation in Arizona..... 456
Extent of Asphalt Pavements of the World..... 456
The Tampico Jetties, Mexico..... 457
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS 448, 449
EDITORIAL NOTES..... 450
Connivance with Favored Contractors in Bidding for Municipal Work—The Invention of Concrete and Iron Construction—The Cost of Switching and Yard Work on Railways—Inspecting the Manufacture of Structural Steel—Philadelphia's Asphalt Pavement—The Recent Test of Bethlehem Armor Plate.
EDITORIAL:
Engineers and Architects..... 451
LETTERS TO THE EDITOR..... 451
Air Cushions for Pneumatic Tubes—The Need of Inspection for Structural Material—Defective Ironwork in Buildings and the Responsibility for It—Adjusting Compass Zeros—The Brooklyn Bridge Terminals.
CONSTRUCTION NEWS..... 457
Railways, Street and Electric Railways, Elevated Railways, Highways, Bridges and Tunnels, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Miscellaneous Contracts and Supplies, Condensed List of Contracts Pending with Date of Opening Bids, Contract Prices, Metal Market Prices.
INDUSTRIAL NOTES..... 460

The Jersey City Board of Street and Water Commissioners has rejected all the proposals for a new water supply and for filtration, received some time ago, and to all apearances the city is no nearer a pure water supply than it was ten years ago.

Surveys for ascertaining the subterranean water supplies in the states of Idaho, Montana, Washington and Oregon lying east of the Cascade mountains and ascertaining the localities at which artesian water can profitably be bored for, are to be made by the geological survey, if a bill now before Congress becomes a law.

A claim for $100,000 for damages claimed to have been sustained by French exhibitors at the Columbian Exposition has been filed in the U. S. Circuit Court by the French government against the exposition company.

The tests of Johnson cast steel shot, recently conducted at the Indian Head proving ground, have resulted satisfactorily. One 500-lb. shot from a 10-in. gun penetrated 4.8 ins. into a 12-in. plate, another (with a steel cap) penetrated 9 ins., and a third went through an 11½-in. plate and its backing.

The staff system of block working has been put in operation on the Chicago, Milwaukee & St. Paul Ry., between Salula Junction and Savanna, 2¾ miles, including a bridge over the Mississippi River. The line is single track with very heavy traffic, and passenger trains are run under the absolute block and freight trains under the permissive block. There are two machines at each end, of the pattern described in our issue of Jan. 18. There are 20 ordinary staffs and one permissive staff with a key for unlocking a case in which six metal tablets are kept. Seven trains may thus be sent, the seventh taking the permissive staff.

A track elevation ordinance for raising the tracks of the Lake Shore & Michigan Southern and Chicago, Rock Island & Pacific railways in Chicago has been practically agreed upon by the city attorneys and the attorneys of the two railway companies, if reports are true. This is a modification of the original ordinance (Eng. News, April 26) asked by the railway companies in their communication of April 30 (Eng. News, May 10). It being impossible to legally make the payment of $100,000 by the railway companies for land damages, a part of the mandatory ordinance demanded by them, however, the agreement is that the new ordinance shall contain a section making it incumbent upon the railway companies to accept the mandatory ordinance, and also making the acceptance of the ordinance dependent upon the payment of $100,000 by the companies. The Committee on Railways and the City Councils have yet to act upon the new ordinance, however, and the position of these bodies in respect to track elevation makes it very uncertain whether the city is any nearer that end than when the railway companies refused to accept the first ordinance.

The contract for excavating Section 1 of the Chicago Drainage Canal has been awarded to Griffiths & McDermott, of Chicago, Ill., for $1,286,219. Bids were received April 18 (Eng. News, April 26, May 3) from 19 contractors for this section, and of these only four were considered in making the final award. These four bids were in detail as follows:

	Quantities, cu. yds.	May & Purington Co. $1,201,037.	F. J. McCain Co. $1,242,247.	Johnson & Bradley. $1,141,107.	Griffiths & McDermott. $1,286,219.
Glacial drift	1,662,476	$0.39	$0.41	$0.395	$0.429
Solid rock	459,724	0.77	0.78	0.83	0.80
Retaining wall, dry	60,188	1.60	1.62	1.50	1.58
" " cement	60,188	2.84	2.87	2.90	2.90
Add price for overhaul	150,000	0.18	0.19	0.08	0.20
Slope paving, sq. yds.	1,154	0.65	0.70	0.50	0.60

The figures show the bid of Griffiths & McDermott to be $145,112 higher than that of Johnson & Bradley and somewhat in excess of those of the two other firms. It was considered, however, that certain irregularities in the lowest bid and the standing of the other contractors did not make it advisable to give them the contract, and it was consequently awarded to the highest bidder. A minority report, however, recommended that Johnson & Bradley be given the contract, and that firm has sued the Drainage Board to secure the award.

An automatic arrangement for supplying a locomotive tender with water from an underground tank without the use of steam-pumps is a somewhat novel system now being experimented with. In the well is placed a closed iron tank of the same capacity as the water tank, above the water level, with a suction pipe to the water and a steam and water pipe extending up above ground, with hinged connections to extend to the tender. The steam pipe is coupled up to a pipe on the engine and when steam is turned on it starts the flow of water. A tender tank of 2,800-gallons capacity may be filled in about three minutes, and the station tank will be refilled automatically in about one minute. In an emergency water may be obtained without the use of steam. The apparatus is manufactured by the Automatic Water Tank Co., of New York, of which Mr. T. H. Muller is President, and Mr. H. R. Winkelmann, Chief Engineer.

The most serious railway accident of the week was the derailment, on May 27, of the New York and Pittsburg express on the Baltimore & Ohio R. R., near Pine Grove, Pa. The engine ran into a landslide and was thrown down the bank, the engineman and fireman being killed. The express cars were wrecked and burned.

The bursting of a lubricator tank on an express engine of the Chicago, Burlington & Quincy Ry., May 24, set fire to the cab while the engine was hauling a train near Kewanee, Ill., and the engineman and fireman were badly burned before the train could be stopped.

A crossing collision occurred at Allentown, Pa., between a Lehigh Valley R. R. coal train and an electric car which could not be stopped on account of the rails being slippery.

An old wooden bridge over Dry Creek, West Troy, N. Y., collapsed May 27, throwing several persons into the creek, but as the fall was only 6 ft. and the water only a few inches deep, no serious injuries were caused. —The Columbus St. bridge over Duncan Creek at Chippewa Falls, Wis., gave way under a team May 23.

A boiler of 15 HP. used to supply steam for drills on Eagle Ave., between 156th and 157th Sts., New York, exploded May 21, injuring five men, two of them probably fatally. It is reported that a wrench had been hung on the safety valve.

The flood at Philadelphia last week stopped traffic on the Baltimore & Ohio R. R., the water in the station at 24th and Chestnut Sts. being nearly up to the ticket windows.

A bridge on the Missouri Pacific Ry. near Pueblo, Colo., gave way under a passenger train May 23, but the train got across in safety.

A plan for the abolition of grade crossings in East Boston has been prepared by Wm. Jackson, M. Am. Soc. C. E., City Engineer of Boston, and is to be considered in conference with the engineers of the Boston & Maine R. R. and Boston & Albany R. R. and the special commissioners appointed by the court on this subject. It will then be submitted to the court, when an order will be issued for the work to be done. It is estimated that the expense will be fully $750,000, of which the state bears 25%. Boston 10% and the two railway companies together 65%. The plan provides for overhead bridges, each to be 15 ft. high in the clear over the tracks.

The terms of the compromise between Mr. Eiffel and the judicial liquidator of the Panama Canal Co. are that Mr. Eiffel will take $2,000,000 worth of shares. He will surrender the Panama bills now in his possession, receiving lottery bonds in exchange. If the company shall not be founded he will pay the liquidator $1,000,000, and surrender the bills on the same terms.

The first train passed through the Palisades tunnel of the new Hudson River terminal for the New York, Susquehanna & Western Ry., on May 23.

The main building of Clemson college, the agricultural and mechanical institution of South Carolina, at Calhoun, S. C., was burned May 23.

The passenger steamer "Northwest," of the Northern Steamship Co., to run between Buffalo and Duluth, attained a speed of 20 knots on her trial trip May 14. She is 383 ft. long over all, 44 ft. beam, 26 ft. deep, and has twin screws driven by triple expansion engines of 3,500-HP. each at 120 revolutions. Belleville water-tube boilers are used. The electric lighting plant is said to be the largest of any ship afloat, there being 1,560 lights. She was built by the Globe Iron Works, of Cleveland.

The War Department has received from the Pneumatic Dynamite Gun Co. the first battery of dynamite guns for coast defense. The battery is composed of two 15-in. guns and one 8-in. gun, and is in place at Sandy Hook, N. Y. The plant must be thoroughly tested before it is accepted by the government, and it is expected that the tests will be very interesting. The company is desirous of making a conclusive demonstration of the merits of this battery, and is endeavoring to secure from the Navy Department one of the old single-turreted monitors for use as a target.

A board of army engineers is now inspecting sites for fortifications on Puget Sound. Batteries of rifled mortars will be established.

One of the piers of the Aqueduct Bridge at Washington is badly cracked. A former crack began to spread in January, and iron straps were put around the pier. Wagons are only allowed to pass slowly and one at a time over the spans resting on the pier.

The new war balloon for the U. S. Signal Corps is spherical in shape, with a capacity of 13,000 cu. ft., and having a lifting power sufficient to carry two men with the necessary signal instruments. The envelope is formed of gold-beaters' skin, which is impervious to the hydrogen gas. The balloon, with complete equipment, is now at the Fort Riley, Kan., School of Instruction, where it is being used in instructing the signal corps at that post.

A new Hudson River steamer, the 'Elaine," has been built for the Hudson River Steamboat Co., by Marvel & Co., of Newburg, N. Y. It has a steel hull with four bulkheads, and is 131 ft. long, 20 ft. beam and 6 ft. draft. The screw is 6 ft. 3 ins. diameter, driven by a 400-HP. compound engine with cylinders 14×18 ins. and 26×18 ins. There are 110 incandescent lights and a powerful searchlight.

A Mekarski compressed air car is being tested on the Woronoco Street Ry., at Westfield, Mass. It carries 300 lbs. initial pressure, and can run eight miles before the pressure is reduced to 100 lbs. This system is in use in Europe, and has been described in our columns. It is being introduced here by the Mekarski American Compressed Air Motor Co., in which Mr. James P. Lewis and Addison C. Rand are interested.

The famous works of the Corliss Engine Co. at Providence, R. I., which have been closed for some time, are soon to be reopened with the following directors: Wm. H. Draper, of Hopedale, Mass.; Wm. H. Bent, of Taunton, Treasurer of the Mason Machine Co.; Stephen A. Jenks, of the Fales & Jenks Machine Co.; S. Holman, Treasurer of the Holyoke Machine Co., and David M. Thompson, Manager of the B. B. & R. Knight's mills. Mr. Thompson will be president and treasurer of the new company and will be its active manager.

The gunboats "Castine" and "Machias," are to be lengthened, and the former has been already cut in two and the two ends pulled apart 14 ft. by hydraulic jacks.

Bullet-proof cloth is the invention of a German tailor who is said to have had sufficient faith in its efficacy to allow himself to be made a target of. The material is woven and is backed by a secret material or composition.

GAS FOR FUEL.

At the recent meeting of the Ohio Gas Light Association, Mr. Donald McDonald read a paper with the above title giving an interesting comparison of the relative value of gas and coal for heating purposes, and of the proper manner of using gas for house-heating. The following are extracts:

In taking up the subject of gas for fuel, I want it distinctly understood that I do not mean fuel gas, whether it is spelled "fuel" or "fool." I am not one of those who believe that any process will ever be discovered by which nitrogen can be burned or can be made to aid combustion, or that any alchemist will ever succeed in greasing one cent's worth of wind with two cents' worth of oil, and making a dollar's worth of gas out of it. On the contrary, I am sure that if gas is ever successful as a fuel, the first requisite will be that it shall be a good gas.

The attempt to use gas for purposes where its cost and other properties make its failure a foregone conclusion tends to retard the use of gas for fuel. For cooking or for occasional fires gas can be used with economy at $1 per 1,000 ft.; but the man who attempts to heat a bedroom or an office with it at that price will certainly become disgusted with the whole business, and will very properly blame the gas company that induced him or allowed him to waste his money on such an experiment. With a good gas at 50 cts. per 1,000 ft. all sorts of cooking can be done with it, and the heating of parlors and dining-rooms, and those bedrooms which are not used as sitting-rooms during the day, can be done at a cost so little greater than the cost of coal that people will put up with it on account of the greater convenience of gas. At 35 cts. per 1,000 ft. for a good gas containing (say) 700 h. u., gas can be used as a heating agent all over a residence and the cost will not exceed that of anthracite coal at $8 a ton, or soft coal at $3.50 a ton, after allowance is made for kindling and labor. Thirty-five cents per 1,000 ft. will sound like a high price to those of my friends who are selling natural gas, while it will sound like absolute starvation to those who sell only illuminating gas. If it is granted, however, that the sales of illuminating gas can be made four times as great in the day-time as they are at night, while not a dollar additional cost need be charged for interest, for repairs, for maintenance of lines, for reading of meters, or for clerk hire, I believe that most gas engineers will admit that where coal and oil are cheap, and other conditions favorable, they would be very willing to have a very large daytime consumption of gas, at a price approximating this figure.

The question of what the consumer can afford to pay for gas for fuel is one certainly as important as the question of what price the company can afford to make the gas for, and one on which very little talent is expended, and one which ought to receive at least as much attention as the proper management of the gas works.

If gas at 50 cts. per 1,000 ft. is burned in a good gas stove, in a tolerably close room, without any chimney draft, the products of combustion escaping into the room, the amount of gas required to heat the room will be so small that coal will not compete with it in price. The room, however, if it is small and close, will become unfit for habitation, owing to the consumption of the oxygen of the air, and the formation of carbonic acid and watery vapor.

Generally speaking, I have found that a stove of this sort placed in the hall of a dwelling house, where the warm air can ascend to the second and third floors, fresh air being in the meantime drawn in to take its place, will not cause any serious inconvenience. I have found also that a bedroom heated in this way can be made hot in two or three minutes, and will contain a very pleasant atmosphere during the hour in the morning that the occupant is rising, or at night when he is retiring. To keep such a fire going all day and use the room as a sitting-room is, however, very unwise; and whenever a room is used in this way the gas fire should either have a good draft, or a window should be lowered from the top, or some other means provided for allowing the products of combustion to escape, and fresh oxygen to enter.

One hundred cubic feet of natural gas weighs 4.287 lbs. It is composed of 1.072 lbs. of hydrogen, and 3.215 lbs. of carbon; it requires for its perfect combustion 969.3 cu. ft. of air, weighing 74.561 lbs. It makes in burning 9.648 lbs. of steam, and 11.788 lbs. of carbonic acid, equal to 100. It produces 94,593 h. u. when the steam is not condensed. The total products of combustion are, therefore: Steam, 9.648; carbonic acid, 11.788; nitrogen, 57.412; total, 78.848 lbs. If these products of combustion escape at a temperature of 600°, they carry off with them 12,712 h. u., or about 14% of all the heat produced by the fire. If they escape at 300°, they carry off less than 7%. Suppose, however, that for any reason, twice as much air as is necessary to combustion passes through the fire, and escapes up the chimney, along with these products of combustion; at a temperature of 600°, we would then have a loss of heat units equal to 23,332 h. u., or about 26% of all the heat produced by the fire. If three times as much air as is necessary for combustion is admitted and allowed to escape at 600°, then the loss is 40%.

It must be remembered, however, that with a wide open chimney and a strong draft, not only is the volume of air which escapes up the chimney increased, but also the temperature is apt to be high. We find, therefore, that if a fire takes in five times as much air as is necessary, and that it escapes at a temperature of 800°, then the loss will amount to 92% of all the heat produced by the fire.

A room 16 × 16 × 12 ft. contains about 3,000 cu. ft. and will require 2,177 h. u. in order to bring its temperature up from 30° to 70°. If the combustion were perfect, and there were no other loss than that due to the actual products of combustion escaping at 300° F., such a room should be heated from 30° up to 70° with the consumption of 3 ft. of gas per hour; or, assuming that the air is changed three times per hour, and that there is no loss through the walls or windows, 9 ft. of gas per hour would keep such a room warm.

I was so much surprised at this low figure that I stopped the preparation of this paper long enough to construct a gas stove on this principle. It was of sheet iron, so constructed that no air could enter it, except what was necessary for combustion, and this air was compelled to enter it at the very point where the flame originated. This I accomplished by using the ordinary burner, composed of a piece of ¾-in. gas pipe, with holes ⅛-in. in diameter drilled 1 in. on centers and fitted on the end with an ordinary mixer and stop-cock, so arranged as to take in air and gas mixed, and provided with valves so that the amount of air and the amount of gas taken in were capable of absolute adjustment. This burner was placed inside of a 2½-in. pipe of the same length, with holes ⅝-in. in diameter, in such a way that the jets of mixed air and gas issuing from the small pipe were projected through holes in the larger pipe, and, of course, met a supply of perfectly pure fresh air drawn in from the outside. The stove was connected to the chimney by means of a 4-in. flue pipe, and there existed at all times a vacuum in the stove, so that whatever leaks accidentally existed in it served to take in air, but never to permit the escape of the products of combustion. I found that with this stove I could maintain the temperature of a room 16 × 16 ft. with a 12-ft. ceiling at 68°, while the thermometer outside varied from 25° up to 35°, the consumption of gas being only 13 ft. per hour, and the room being at all times sweet and wholesome.

In pursuing this inquiry, I have examined the cuts of all the gas-burning appliances which I could obtain; and in none of them do I find any attempt to separate the products of combustion from the surplus warm air before they reach the chimney. They all go on one or two theories; the first is to carry nothing up the chimney and allow everything to escape into the air of the room. This may be described as very cheap and very nasty. The other plan is to provide ample chimney draft, and let the householder pay the bill. This is healthy enough, but it is very expensive.

The next question and one equally important is, at how low a price can gas companies afford to sell a first rate gas? There is no doubt but that a natural gas company can afford to manufacture artificial gas to supply the deficiencies during cold weather, and sell the mixture for 35 cts. per 1,000 ft. and even much cheaper. The question as to what illuminating gas companies can do in this line is one not so easily settled. Assuming, however, that none of the expenses of the illuminating gas company would be charged to the cost of furnishing the fuel gas, except the interest and repairs on the additional apparatus, and the cost of the additional fuel and labor necessary to make the extra amount of gas, then I believe that a very fair profit would be found in selling 18-c. p. gas, to be used as fuel at 40 cts. per 1,000 ft. If this were done and the attention of the public properly called to the advantages of this fuel, I believe that I am not a false prophet when I say that the time would come when the receipts from gas sold for fuel would greatly exceed the receipts from gas sold for light.

With regard to the question of how this gas is to be made, I can only say that my experience in the line of making artificial gas is not long enough to entitle my opinion to any great weight on this subject. It is evident, however, that what is wanted is not cubic feet, but heat units, and that in order to get these heat units at a reasonable cost, we must get them from substances in which the heat exists at a reasonable cost. For instance, if gas containing 700 h. u. per ft. is to be sold for 40 cts. per 1,000 ft., then the cost of 1,000,000 h. u. is 57.14 cts.. Now then, if this gas is made entirely from naphtha distillate at 2½ cts. per gallon, then each 1,000,000 h. u. in the gas would cost the company, exclusive of labor and all other items, about 18 cts., provided all the heat in the naphtha could be gotten into the gas. As a matter of fact, however, only a percentage of the heat existing in the naphtha can be recovered in the gas, and I shall assume that this percentage is 60. On this basis the heat units in the naphtha gas would cost the company for gas making material alone 30 cts. per 1,000,000 h. u. With coke at $3.50 a ton, rating it at 14,000 h. u. per lb., and assuming that the same percentage will be recovered, the gas would cost the company 19 cts. per 1,000,000 h. u. With soft coal at $1.50 a ton, 14,000 h. u. per lb. and the same assumption as to the percentage of heat to be recovered in the gas, we would have a cost to the company of 8.9 cts. per 1,000,000 h. u. These figures seem to force the conclusion that when gas is made at a price low enough to be sold as a general heating agent, it will be made with soft coal, and may or may not be enriched with crude oil or naphtha.

Having come to the conclusion that cheap gas must be made out of soft coal, the next question is: By what process can it best be made? Of course the coal can be distilled off in retorts in the ordinary way, yielding about 10,000 ft. of gas for each ton of coal, and the coke can then be placed in a water gas apparatus, and, by passing steam through it, about 30,000 ft. of water gas can be made, giving a yield of 40,000 ft. of gas to a ton of coal, not counting coal burned under boilers, or fuel used for heating retorts. This process would be very wasteful of labor, and also wasteful of heat, as it requires the coke to be first cooled down, and then after moving it to another apparatus to be heated up again.

The author then proceeds to describe the plant in use at Louisville, in which a water-gas plant is combined with the retorts of a coal-gas plant. This apparatus was erected by the National Heat & Power Co., of Philadelphia, and experience with it shows a consumption of material per 1,000 ft. of gas about as follows: Gas coal, 35 lbs.; boiler coal, 13 lbs.; coke, 10 lbs.; oil, 2½ gallons. The gas made is a good quality of illuminating gas, and rich enough in heat units to allow it to be mixed with natural gas in almost any proportion.

RAILWAY SWITCHING AND YARDS.*

By E. K. Turner, M. Am. Soc. C. E.

Most railways receive from other companies a large part of the cars which they haul over their roads. These cars are received in trains made up by the delivering road, in the manner that is most convenient for itself, without regard to the destination or movement of the cars over the receiving road. The latter has, therefore, to assort and arrange in proper order the cars thus received, so that its train and car movements may be reduced as much as possible. This work can be done better and at a less cost in a yard fitted for the purpose and furnished with proper power and appliances than on the road by the train engines and crews. For those of the New England railways reaching tide-water, the classification of cars received from other roads is as follows:

(1) Those containing freight for export. These cars, either at the receiving point or as near it as is practicable, should be made up into trains, which should run through, without further switching, to the tide-water end of the road, either to the docks or to the yard in which cars for the docks are held.

(2) Cars containing local freight, that is, freight for points on the receiving road. This can be divided into classes again, such as freight which should have immediate dispatch, live stock being a type of this kind of freight; perishable goods and those of great value, which should have prompt dispatch, but need not be hurried forward as quickly as live stock; and cheap freight, such as coal and heavy merchandise of similar description. This does not need to be hurried forward, but may be handled in the most economical manner, even if more time is used in transporting it.

(3) Cars containing freight for stations on other railroads, which are to be delivered to them at the various junction points where these roads are met or crossed.

(4) Cars requiring repairs. As soon as a train is received, it is inspected by the car inspectors of the receiving road, or in some cases by joint inspectors, representing both roads, and those cars which are broken or do not meet the requirements in force for the reception of cars must be separated from the others and placed on tracks where they can be repaired, or the freight which they contain transferred to other cars. Unfortunately, this class is not a small one, and adds very materially to the switching work at receiving points.

In arranging the cars, the main objects sought are to prevent unnecessary movement of trains and cars and

* Condensed from a paper read before the New England Railroad Club.

to run with full trains. In the receiving yard, through cars, or cars going to the terminus of the line, are separated from the local cars, or those going to stations on the line. On most New England railroads the term "through cars" can also be applied to those destined for other railroads, which are delivered at junction points. When the number exchanged is considerable, these cars can be considered as through cars, but if the number exchanged is small, they must be treated as local cars, and the junction as a local station.

The through cars can thus be made up into trains, which can move on to their destination without stop or extra movement so far as the train itself is concerned; the only movement other than the continuous one in the direction of its destination being that required to take the side track in case the train is to be passed by one of superior class on a double-track railroad, or to meet or be passed by a train on a single-track road. With proper arrangements for passing on side tracks, the lost movement due to this cause can be made very slight. A train entering a side track at one end and passing out at the other moves toward its destination, and the loss occasioned consists only of those items, such as wages and fuel, which continue while the train is at rest.

With local cars the case is different. The cars for each point must be placed together, so that in making up a train the cars can be put in station order, as it is called. Those for the first station are placed next to the engine, those for the second station next to them, and so on, in order that the locomotive may move as few cars as possible when it sets cars from its train on to the side track at a local station. A little work and care in this direction may save much time and work to trains on the road, as the small yards at local stations are not adapted to switching, and the less movements there are made at such points, the better the results with regard to both safety and economy.

If freight is transferred at the reception point, cars containing such freight and the cars into which it is to be moved should be placed at the point where transfer can be made safely and conveniently. Generally, in yards where this kind of work is done, a covered platform is provided a short distance away from the switching territory.

The result of all these movements noted is that the cars must be entirely rearranged as to their order and position in trains, and those arriving in one train are liable, almost certain, to go forward in many different trains. Each car received is handled at least once, and most cars many times, before they are ready to be forwarded to their destinations.

Cost of Switching Movements.

The expense incurred in switching is one of the largest items entering into the cost of operation of railroads. In New England the mileage charged to freight switching is over one-third as great as the mileage run by freight trains on the road. On some of the railways the proportion is even larger. Taking the figures given in the Massachusetts Railroad Commissioners' report for the year ending June 30, 1892, the mileage of the five railroads terminating in Boston was as follows:

	Passenger.	Freight.	Switching.
Boston & Albany.....	2,909,074	2,557,276	971,813
Fitchburg	2,222,574	3,393,163	1,072,004
Boston & Maine.....	6,387,046	4,351,597	2,115,850
N. Y. & New England..	2,270,539	2,420,842	1,089,312
Old Colony	3,947,583	1,501,252	1,157,402
	17,736,816	14,124,130	6,406,381

Of the switching mileage, about one-tenth is for passenger service and nine-tenths for freight service. Take out 10% from the total switching mileage, 6,406,381 — 640,638 = 5,765,743, the freight switching mileage, which is 41% of the freight mileage.

This mileage of switching engines is of course arrived at not so much by actual measurement of miles run as can be done with engines hauling trains on the road, as by allowance for time spent in such work. A regular allowance of five or six miles per hour is made.

(The author then undertakes an estimate of the cost of switching on the five New England railways above named. He takes first the expenses of these roads for fuel, water and repairs for locomotives, wages of locomotive and trainmen, train supplies, shops and tools, road repairs, car repairs, rails, ties, general supplies, and wages of switchmen. The proportion of these expenses chargeable to freight traffic he finds to have been $11,754,000; assuming now that the proportion of this sum properly chargeable to freight movement and to switching is represented by the proportion of freight train mileage to the mileage of switching locomotives, he finds the total expenses for switching on these five roads to be $3,407,554 per annum.—Ed.)

The expenditure made in providing tracks and room for switching is also large, but it is so closely connected with the cost of facilities provided for loading and unloading, and for storage of cars either loaded or empty, that it is difficult to separate the items.

In stations of little importance, the station tracks are also switching tracks and serve for one purpose or the other, according to the needs at the time; but in stations of large traffic the tracks are usually distinct. It has generally been found that the yards provided in the earlier days are entirely inadequate for the greatly increased business of later times, and it has been necessary to enlarge them. This has often been done by adding to the yards a little here and a little there, as the pressure for more room became too great to be longer resisted. The result is that the yards have grown into great collections of tracks without order or system, in many cases covering more territory and containing a greater aggregate length of tracks than would be needed if the tracks were properly arranged, and adding greatly to the perplexity and expense of doing the work.

A few statistics bearing on the cost of yards and tracks used for switching and other purposes may not be without interest. The Commissioners' report already quoted shows that the five Boston railroads have, of tracks owned, 3,619 miles; of this, tracks designated as side tracks constitute 1,015 miles, or 28% of the whole. The average cost of these side tracks, including grading, is not less than $12,000 per mile, giving a total cost for 1,015 miles, $12,183,480. The land on which these yards are built, at two acres per mile of track, measures 2,030.58 acres, which at a cost of $3,000 per acre gives $6,091,740. Add to this for buildings used for yard purposes $50,000, making a total expenditure of $18,325,220. At 4% the interest on this sum will amount to $733,008. Of this, at least one half is for switching purposes, or $366,504, which may be added to the yearly cost of switching on the five railroads noted.

There is another item, which every one who has given attention to this subject will admit is a very important one, although it cannot, without more trouble than any one has yet seen fit to take, be definitely separated from the general cost; that is, the large proportion of damage to cars caused by switching. Taken on a locomotive mileage basis, the damage to cars by switching is much greater than by regular movement in trains, so that figures already arrived at, being made on a mileage basis, are certainly not larger than they should be.

Methods of Reducing Cost of Switching.

In order to reach this object, concentration of work is the first point to be considered; that is, the location of yards so that as much as possible of the work shall be done at one yard instead of having it distributed over many. In every yard where switching or drilling of cars is done, a certain organization must be maintained, consisting of a yardmaster, with a day foreman, a night foreman, switch engines and crews for both day and night work, trainmen, transfer men, clerks, and office men. If the work can be all done in one yard, but one organization of this kind is needed, while with several yards as many organizations as yards must be maintained. It is better and cheaper to have one large organization than several smaller ones. The higher employees, such as yardmasters and foremen, can take care of a large amount of business as well as a small one. Engines can be kept at work to better advantage and have less lost time in a large yard. The cost of construction and maintenance is generally less for one large yard than for several small ones having an aggregate capacity equal to the large one. So that as a measure of economy it is better to construct one good yard, well designed and well built, than several small ones.

Concentration in the yard is also important; that is, the yard should be so laid out that the least possible movement of engines, cars, and men need be made in doing the work required. Switches in constant use should be so arranged that switchmen can pass readily from one to another. All of the switches that one man can attend to should be put as close together as possible. Place the stands so that the switchman will not be obliged to cross the tracks in passing from one to another. In yards where a large traffic is handled, it will be found economical to handle the switches from a tower by means of levers, and safer to have them interlocked.

If the yard and all accommodations connected with it are designed with the object of economy of movement constantly in view, the result must be economy of expenditure, as all movement causes expense, even that of light engines to and from their work.

In designing a yard everything should be so arranged that cars will always move in the direction of their destination. No backward movement should be made if it can possibly be avoided; every turn of the wheels backward causes loss. This principle should be considered in designing smaller yards and side tracks as well as in large yards. Consideration should also be given to so laying out all yards and tracks that cars can be reached easily when they are to be loaded or unloaded, the prompt movement of cars being desired. Cars should be considered as vehicles, not as storehouses, and every effort made to keep them constantly moving. The more quickly a car is worn out by proper movement, the better it answers the purpose for which it was built.

Provision must be made for housing the engines and providing fuel and water for them, and men must be furnished to take care of them. There is generally at the end of each division suitable provision for the care of engines. For this reason it is advisable to have the yard at the end of a division. Again, if the yard is at the end of a division, no extra movements are needed to get engines from the round-house to their trains, or from their trains to the round-house. In case of an unusual rush of business, power and men can be provided more promptly and with less trouble. It is also better and cheaper to have the engines housed, and taken care of at a large house with others, than to be obliged to establish a small one for the switching yard alone. The same remarks will apply to the fuel and water supply. At most division points, where road engines are housed, a small plant for repairs is placed. If the yard engines are kept at the same house, advantage can be taken of this plant to have minor repairs made without loss of movement caused by sending them to the shop.

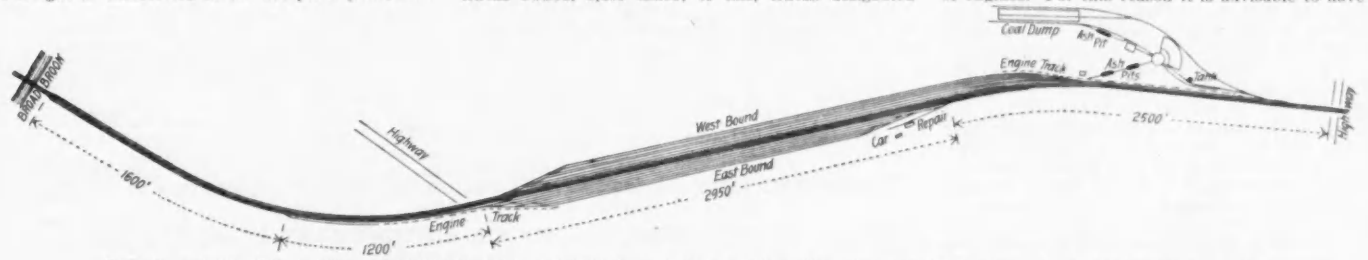


FIG. 1. PLAN OF YARD ARRANGED FOR SORTING CARS BY POLING; FITCHBURG R.R., WILLIAMSTOWN, MASS.

On general principles, the main switching yard should be at the receiving end of the road or as near as possible to that point; but the conditions may be such that it is advisable to place the main yard at some distance from the end of the road. One instance which has come under the observation of the writer is of this kind. The road has three receiving points at its western termini, where it receives cars from connecting roads. Rather than establish three sorting yards, each with its organization of switching engines and gangs, it was thought better to concentrate the work of sorting and making up trains at one point. The first available point, where land could be obtained and a yard built, without great expense, was at the east end of the western division. Trains arriving at each of the three receiving points were forwarded to the sorting yard, after taking out broken cars and those destined for local points west of the main yard, thus avoiding the necessity of a large switching yard and organization at each of the three receiving points.

With the older yards and the old method of switching, there is a great deal of lost movement. A large proportion of the car-switching movement is without good result. As an instance, take a train of 30 cars, each pair of cars being cut from the train, what will the movement be? Each movement made by the locomotive covers about 500 ft. in each direction; at first with the whole train, each successive movement reducing the number of cars attached to the engine and

moving with it. Adding the movements gives an aggregate of 2 locomotive miles and 21 car miles. With a well-arranged yard these movements can be very much reduced. If the yard and engine are fitted for poling the cars with the train of 20 cars noted above, the total car mileage is reduced to 6, making a saving in movement of 15 miles.

Of course, all members of the club are familiar with the process of poling or staking cars. The train to be sorted is placed on a track from which the switches lead to tracks on which the cars are to be placed. Parallel with this track is another on which the engine moves back and forth. The train being placed, cars are cut off from the end nearest to the switches, and, as cut off, are pushed by means of a pole or stake fastened to the engine, only enough motion being imparted to them to carry them on to the sorting tracks. Having started one cut, the engine runs back and starts a second cut, and so on until all of the cars in the train have been disposed of. The writer has been informed that in one yard where this method of switching has been followed for some time, the same force handles one-quarter more cars than by the old method.

The Poling Yard at Williamstown.

An example of a yard of this description is shown on the plan, Fig. 1. This yard is at Williams town, on the Fitchburg Railroad, and was constructed in 1887. The east-bound cars are all sorted at this point. The west-bound cars, as a general thing, go through without sorting, further than to separate cars for the three terminal points. The yard being on both sides of the main tracks, it is not necessary to cross those tracks with freight trains.

Beginning at the west end of the yard, the east-bound cars will be followed first. A switch near the bridge over Broad Brook leads from the east-bound main track. A single side track is parallel to the main for a distance of 1,600 ft., or one train length; then a switch from the first side track leads to the second, which is the track on which the engine moves while poling cars, marked "engine track" on plan. A cross-over, just west of the highway, admits of reaching the first side track with the switching engine, to haul trains up into position for switching, or to push cars already switched to the east end of the yard.

East of the highway another cross-over connects the first side track with the east-bound main track. This is used by the engines which have brought trains and are going to the round-house. At and east of the highway switches lead from the first side-track to six others, so that seven lots can be made of each train. If it is necessary to make still further subdivisions, several kinds can be thrown together on one track at the first switching, and afterwards hauled back and again divided.

It will be noted that the switches have been concentrated as much as possible. Probably at some time they will be operated by levers from a tower, which will still further reduce the force necessary for the operation of the yard. As the entire length covered by the groups of switches on both sides of the main tracks is less than 800 ft., this arrangement can be carried out without difficulty. From the highway to the east end of the east-bound yard is 3,000 ft. When the yard was built it was thought that a series of cross-overs or slips about midway would be needed in order to handle cars conveniently, but the work has so far been done without them.

At the east end of the yard a car-repair track with small shops has been placed, where minor repairs can be made and cars placed in trains without much extra movement; 500 ft. farther east the first side track enters the east-bound main. West-bound trains enter the yard at the switch leading from the west-bound main to the first side track at the east end of the yard. In case the trains are to be sorted or switched, it can be done in the same manner at the east end of the yard as the east-bound cars are handled at the west end. The number of side tracks is the same on each side. The greatest number of cars which has been handled through this yard in one month is 35,000, about equally divided between east and west-bound.

This method of switching can be introduced into a large proportion of the yards now in use, for a portion of the work, with less outlay for change of tracks and new appliances than would be required for any other departure from the old methods of working; but to reap the full benefits of the change in method would generally require the complete reconstruction of the older yards.

From the observation of the writer, the saving made by staking or poling cars in a yard properly arranged for this method of working will be at least 20% of the cost of doing the same work by the old methods. The saving is comprised in the following items: First, less yard room is needed, since less engines and gangs need be at work at the same time. Second, less force is needed to do the same work; lighter engines can be used, having less cars to move at one time; this also results in a saving of fuel, wear of engines, and wear of track. Third, less breaking of cars and less car movement.

Switching by Gravity.

There are not as many places where the gravity systems can be used with advantage as where the poling method can be applied. A grade must exist or be made at the entrance to the switching yard, or in the receiving yard, sufficient to admit of starting the cars and keeping them in motion when the brakes are released. This requires at least 40 ft. to the mile, and it is better to have a little more. The writer is not aware that there is any yard in New England where this method is used to any considerable extent.

At Philadelphia, on the Pennsylvania Railroad, there is a yard where switching is largely by gravity, but not entirely. Cars from the West are received in a yard where they stand until switched. The grade throughout the series of yards is 0.93%, or 49 ft. per mile. Two engines are used to handle the cars; the first one starts the train or "draft" of cars to be switched from the receiving yard on to the westerly of two parallel tracks, reaching from the receiving yard to the yard in which the cars are sorted. The tracks in the sorting yard lead from this westerly track.

The second engine moves back and forth on the easterly of the two tracks; it is fitted with stakes for pushing the cars in case they do not move fast enough. It also has a platform car provided with seats attached to it. As soon as trains arrive in the receiving yard, they are inspected and marked on the end towards the sorting yard, with a figure indicating the track on which they are to be placed. The mark is generally made with white chalk. When the train is started from the upper yards the pins are pulled, dividing up the train; a brakeman rides each cut of cars; if there are several cars in one cut, more than one brakeman go with them.

Part of the switches leading to the lower yard are thrown from a tower, and part from levers on a level with the tracks. The switchmen are governed by day by the figures on the ends of the cars. At night, lantern signals made by the brakemen on the cars convey to the switchmen the same information. There are from 16 to 24 brakemen on duty at once. When cars enough have been started down to take all of the men, the second engine runs down on its track to the lower yard, takes the men on its car and brings them back, ready for another draft of cars. The greatest number of cars handled in a given time in this yard is 920 in three hours. At times the daily number has been as high as 4,500, counting the cars in both directions. The present average day's work is 2,300. The tower handles twelve switches, part on each side. The most distant switch moved from the tower is 500 ft. away.

The yardmaster states that the cuts will not average two cars each. His estimate of the force needed to switch the cars in the old way is 5 locomotives and 30 men. Considerable more yard room would be required to admit of working such force.

Although good work is being done in the yard last described, still it is not considered just right for the work, and the company's engineers are now at work on plans for an improved yard which can receive all cars arriving at Philadelphia, and sort them with the least possible delay and movement. If this plan is carried out, the yard will be a model.

In England and on the continent of Europe, much attention has been given to the subject of switching and yards, as well as to all other details of operation. One of the first yards built with a view to saving movement and using gravity to bring about such movements as are necessary is the Edge Hill yard near Liverpool, on the London & Northwestern Ry. This yard was built from the designs of Mr. Footner, one of the principal engineers of that company. The following description is an abstract from the account given by the late Sir George Findlay, General Manager of the London & Northwestern Ry., in a work published in 1889.

Edge Hill is on the Liverpool and Manchester line of the London & North Western Ry., about one and one-quarter miles from the terminus in Liverpool. Several branch lines unite here with the main line, as shown in the plan. They lead to the various freight stations in the city. In 1889 534 trains per day were handled in and out of Edge Hill. All trains for Liverpool are broken up at Edge Hill and the cars sorted for the various stations. Also all cars from Liverpool are here brought together and made into trains to be forwarded in all directions. The yard was begun in 1873. It occupies 200 acres and contains 57 miles of tracks. The tracks consist of, 1, six reception tracks at the summit, holding 294 wagons. (It must be kept in mind that the wagons, or freight cars, are only about one-half the length and weight of American cars, the Standard length being 15 ft. 6 ins. and the capacity 7 tons.)

2. The sorting sidings, 24 in number, holding 1,065 wagons, into which the wagons are first run, each siding receiving wagons for a train.

3. Two groups of marshalling sidings, which, owing to their peculiar formation, have been christened "gridirons," through which the cars are run in such manner as to bring them in station order.

4. The lower reception and departure tracks, where the trains are ready for departure and where the road engines take them. Room enough was left to nearly double the capacity of the yard when the volume of business should require it.

When a train arrives in the upper yard, the rear brakes are applied and the engine detached. Then on each wagon is chalked the number of the siding on which it is to be put. One man inspects the brakes on each wagon and calls out the chalked number to a second man standing below him, who has to regulate the speed of the descending wagons. This second man passes the number on, by hand signals, to the switchman lower down, who has charge of the switches, and by moving a lever turns the wagon into the proper siding.

By the process thus described, each siding now holds a separate train, although the wagons comprising it are

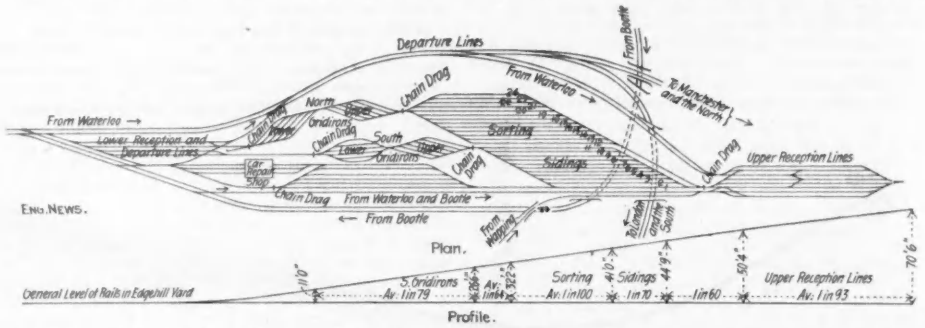


FIG. 2. GRAVITY YARDS OF LONDON & NORTHWESTERN RY. AT EDGE HILL (NEAR LIVERPOOL).

in indiscriminate order, but by a repetition of the operation the wagons of each train are separated in the gridirons and sent from them into the departure tracks in proper order.

At the narrow points, between the groups of tracks, will be noted the words "drag chain." This indicates the location of a chain, weighing four or five tons, laid on the ties. At the upper end of this chain is a large hook, so arranged that its normal position is up, so that it will catch on the axle of a car passing on the track. It can be lowered by means of a car passing on the is desired to have the cars pass. If a car escapes from the control of a switchman, or for any cause it should be stopped, the hook is allowed to catch on the axle. The chain, by its weight dragging on the ties and gravel, stops the car. There are six of the drag chains at Edge Hill.

The gradients of the sidings vary, according to the requirements, from 1 in 60 to 1 in 115. For instance, through points and crossings, and around the standard curves of seven chains radius, the gradient is from 1 in 70 to 1 in 100; but on straight lines, where wagons have to start singly and enter curves, as, for example, at the lower end of the wagon tracks, at the lower end of the sorting sidings, and at the lower end of each siding in the gridirons, the gradient is 1 in. in 60. On the other hand, on straight lines, where many wagons move together, and good "runners" compensate for bad, the gradient is from 1 in 100 to 1 in 115. All of the curves are of the same radius (seven chains), so that a switchman, on determining the speed necessary for any particular car, may concentrate his attention on it, knowing that the resistance of every curve it encounters will be the same. Speaking generally, the gradients are so regulated that the greatest momentum is imparted where the cars are required to start quickly, and where the greatest amount of resistance is to be overcome.

During the year 1887, 518,000 loaded wagons were passed through these sidings, in addition to 108,000 empty wagons, making a total (exclusive of special trains) of 626,000 wagons, or a daily average of about 2,000. There are 83 men employed to work the sidings, including 9 foremen and inspectors.

One special advantage claimed by its inventor for this system of marshalling wagons is that it can be carried out by any active man without previous training, the operation being so simple that the work can be learned in a week or two, and the only man who is really required to be possessed of geographical knowledge and experience being the one who chalks the numbers of the sidings on the wagons.

On several French and German railways another form of gravity switching is used, which can be applied in many cases where a long grade like that at Edge Hill is out of the question. A receiving yard and a delivery yard are constructed alongside the main line at the same level with it at a distance apart of from 1,000 to 2,000 ft. The track connecting the two yards

is raised at its middle, so that there are grades of 1% on each side. An engine pushes a train out of the receiving yard, the cars are cut apart on the up-grade, and, as they are pushed over the summit, run on the down grade to the tracks of the delivery yard. The cars are marked on their ends so that the switchmen know which switch to turn for them. If the delivery tracks are long, the grade is continued on to them sufficiently far to carry cars to their ends. After the train has passed on to the delivery yard, the engine takes the men back to the reception yard and pushes out another train.

If it is desired to arrange the trains in station order, a second grade track and a third yard must be provided. The great advantage of this method of switching is due to the small extra expense involved in construction, and to the fact that it can be applied in many cases where it would be impossible to construct a gravity yard of the Edge Hill type; the only departure from the grades of the main tracks being the comparatively short tracks joining the yards.

On several railways in Europe experiments have been made to find the comparative cost of switching by the various methods. A few of the results are as follows:

Authority.	Cost of switching per car. By engine.	By gravity.	Saving by gravity.
German Govt. Commission.	6.9 cts.	2.8 cts.	59%
Paris, Lyons & Med. Ry., by M. Michel, Chf. Engr..	5.1 cts.	3.3 cts.	35%
Northern Ry.....	4.0 cts.	2.9 cts.	30%
Swiss Western Ry.....	.....	2.8 cts.	....

While comparison of cost is difficult, the writer believes that in this country cars can be switched by gravity 25% cheaper than by the old method with the engine attached.

It has been noted that wherever the gravity method has been adopted the number of accidents to employees has decreased in a marked degree, giving a strong argument in favor of this method from a humanitarian point of view as well as from an economical standpoint.

In laying out a gravity yard, there will be needed (1) a reception yard in which the road engines leave the trains; (2) a sorting yard into which cars run from the first, and comprising as many tracks as there are divisions to be made; (3) a smaller yard, which can be reached from all tracks of the sorting yard, and in which trains got together in the sorting yard can be arranged in train or station order; (4) a departure yard, in which trains arrive, ready to be forwarded to their destination.

Sorting and Transfer of Local Freight.

Whatever method of switching may be, there are some elements of saving that can be profitably introduced. One point, which has been brought to the attention of the writer, and which should receive greater attention than has been given to it on most railroads, is that of transfer of freight at receiving points.

Freight is received for local stations in mixed carloads; that is, freight for several stations in the same car. With a convenient transfer platform at the receiving yard this freight can be handled cheaply and consolidated into carloads for the larger stations. We will suppose freight for one station is in 10 cars: each car contains freight for 10 stations. Unless the transfer is made, each of these cars is liable to be 10 days on the road, being set off and left at least one day at each station for which it has freight. This results in loss of the 10 cars 10 days each, also in the expense of switching the cars at each station by the local train, in delay in the delivering of freight, and in extra work for the station men at local stations, where the force is generally small and not so well prepared to overhaul the contents of the cars as the force at a well-equipped transfer station.

Following out in detail the case noted—10 cars of mixed freight for 10 stations. The work at a receiving yard would be simply taking the cars to the transfer platform and back into the yard; say, for 10 cars, 5 car miles and 1 locomotive mile. When taken on the train each car will require one half-mile movement of itself and the locomotive to place it on the side track, and after it is unloaded the same movement to take it out, making 10 car miles and 10 locomotive miles. Taking the case of stations situated as follows, the stations being denoted by letters, the distance between stations by figures: A, 2½; B, 2; C, 2; D, 3; E, 2½; F, 2; G, 3; H, 4; I, 6; J, 5; K, the road movements outside of switching required to move the ten cars out and back to the starting point will be 640 car miles, while the car movements, if proper transfer has been made, will be 292 miles, the locomotive mileage being the same as before.

	In yard, cars	loco.	On road, cars	loco.	At station, cars	loco.	Total, cars	loco.
Not transferred...	0	0	640	64	100	10	740	74
Transferred	5	1	292	64	10	10	307	75
							433	— 1

The time occupied by cars to make the round trip, if not transferred, is 121 car days; if transferred, 20 car days—a saving of 101 car days. A further saving is made by not encumbering the local yards, and consequent decrease of work in local switching and in damage to cars; by saving in car mileage charges for use of foreign cars; and, more than all else, by prompt delivery of freight.

The arrangements recently made by the New England railways to charge for the use of cars after a stated time at delivery stations, if carried out, will have the effect of giving those in charge of car movement an increased interest in this question of transfer. When cars stood at stations indefinitely, waiting to be unloaded, it was not so much of an object for a railway to have its own cars in this business; but with prompt unloading a road can make quite a saving in its car service account by transferring freight from foreign cars to its own at the receiving point.

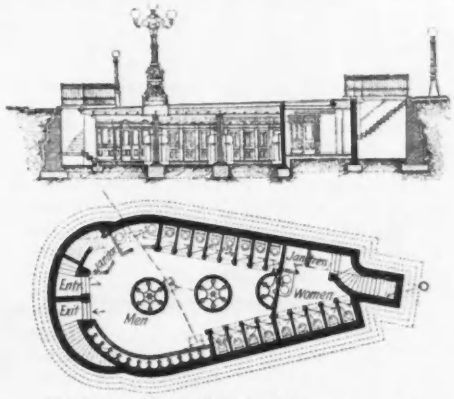
For the year ending June 30, 1892, the five Boston railways already noted paid for balance of car service $691,241. The saving which can be made in this item, like many others in the operation of railways, depends largely upon the judgment and care of the man in charge. If he understands his business and has proper discretion in selecting cars for transfer, his company will save money and give better satisfaction to its patrons by reason of his work.

The business now done by the railways has so changed from that of the earlier days that the old facilities and methods are entirely unsuited to the work. It can almost be taken for granted that an appliance or method is not to be used now because it was used in those earlier days. While everything else has changed, our methods of switching, and yards in which to do it, have in most instances remained the same. A reorganization in both is needed, and the railroads which carry out such reorganization, on the proper lines, will at once note a good effect upon their expense account.

PUBLIC LATRINES IN LONDON.

A public latrine has lately been built near Charing Cross, in London, which has some features worth following in our own large cities. In the first place, it is underground and consequently non-objectionable as a feature in the landscape, and it provides the maximum of accommodation and privacy.

This Charing Cross latrine is divided into two compartments, one for each sex. That for the men contains 28 urinals, 12 water-closets and two sets



Public Latrine at Charing Cross, London.

of washstands. The urinals are free, but a small fee of one penny (2 cts.) is charged for the use of the closets and the washstand. The closets are opened by dropping the requisite coin into a slot outside of each door, and a single attendant in charge is all that is necessary.

The interior walls are lined with glazed bricks of an ivory color, with all the woodwork in oak. Light is admitted from above through Hayward prismatic lenses, and connection with the sewer is made in such a manner that absolute ventilation is secured. The highly ornamental lamp post above is hollow and acts as a ventilating chimney, and circulation of air inside is provided for further by cast iron gratings in the top of the partition dividing the two compartments. We are indebted to "Le Genie Civil" for the cut here used. Similar latrines are in use in other parts of London.

There are many places in our larger American cities where similar latrines could be located with great convenience to the public; and there is an urgent demand for them, far in excess of the very limited accommodation now provided. They need not be expensive, for all exterior ornamentation is avoided, and the sunken type is much to be preferred even were the expense of construction greater. The lamp post which indicates the location and serves as a ventilator is practically the only portion appearing above the surface except the railing surrounding the entrances.

THE PRESENT AND PROPOSED SOURCE OF WATER SUPPLY OF SAGINAW, MICH.

In response to a request for information regarding a proposed new source of water supply for Saginaw, Mich., Mr. W. R. Coats, the engineer employed in connection with the new supply, has sent us the following regarding the present river supply and the proposed supply from an open but deep well:

Twenty-one years ago this city started out in the development of a public water supply system, being one of the pioneer inland cities in this field of public improvement. The city then had a population of about 10,000. At that time simple fire protection was the chief aim in the development of a public water supply system, sanitary questions being given very little attention. Hence the river was chosen as the source of supply, it being the most easily accessible.

From a sanitary point of view there are very few rivers in the country so unfit as a source of water supply for domestic uses as is the Saginaw River. The watershed of the river and its tributaries embraces a section of country of as rich soil as can be found anywhere, which, until artificially drained, includes large areas of swamp lands. For the last 40 years these rivers have been the largest log-running streams on the globe, the logs being cut into lumber by the mammoth mills of Saginaw and Bay City, the product running some years as high as 1,000,000,000 ft. B.M. After the spring run of logs, and before the mills start up, these streams are packed full of logs for a distance of 100 miles from the mouth. Most of these logs shed their bark while lying in the water, and this bark, when saturated, sinks and becomes imbedded in the mud at the bottom of the stream. The bark in its decaying, discolors and contaminates the water and together with the storm-wash of the rich soil always keeps the water of the river turbid. But this is not all or the worst of the evils. For 16 miles from its mouth the river is virtually at the lake level, and the formation of the Saginaw Bay, into which the river flows, is such that when the wind is in a certain direction the current of the river is up-stream. At such times all the sewage of the cities on this lower stretch of river, now having a combined population of 150,000, is carried up-stream, still further poisoning the public water supply of Saginaw.

The situation has become so critical and alarming that sheer public necessity demands a remedy. This city has a population of more than 60,000, and has perfect water and rail connection with the entire country. It is the center of one of the richest farming sections on the globe, and its only drawback is an inadequate supply of pure water.

There are two certain ways of obtaining such a supply: One way is to go far out into the bay and another way is to go 50 miles inland and gather the waters of the higher levels. But either of these plans involves several million dollars of expense and cannot be seriously considered except as a last resort.

It is found that a very free water bearing stratum of sand and gravel exists at the depth of about 100 ft. below the surface, and when tapped the water rises to within a few feet of the surface. At an early day it was found that the waters of the deeper strata were salt. About the year 1860 the first salt well was put down and within an incredibly short time the Saginaw valley became the largest salt producing section in the world. It was perhaps natural, in view of this large salt production, that the popular belief should hold that all the subterranean water of this locality was salt, and unfit for domestic purposes. The result of my investigation has shown that this is wrong, and that no salt seriously affects the water until a point far below this 100-ft. stratum is reached.

The good quality of this subterranean water being satisfactorily established, it only remains to determine whether an adequate quantity can be obtained to supply the needs of the city. This is the aim of my present work and the prospect is that the necessary quantity will be found. Our test well, only 6 ins. in diameter, gives a flow of 175,000 gallons per day, and several smaller private wells give a flow of 100,000 gallons and upwards.

My plan for the development of this public water supply will be to sink a circular caisson 100 ft. in diameter and 60 ft. deep, to serve partly as a storage well to meet emergencies, and within this well to sink another 50 ft. in diameter, to the further depth of 60 ft., or the water bearing strata. If the yield of this larger well should prove relatively only 0.5% as great as the flow of the smaller wells it would give over 10,000,000 gallons of water per day. In utilizing this source of supply it would be necessary to place the pumps about 25 ft. below the surface.

SPECIFICATIONS FOR STEEL FOR RAILWAY BRIDGES.

We are indebted to Mr. Geo. H. Thomson, M. Am. Soc. C. E. (formerly Bridge Engineer of the New York Central R. R.), for a copy of his new specifications for structural steel for railway bridges, which have been prepared with a view to covering the difficulties in the way of securing suitable material at reasonable cost for structures of absolute permanence; the amount of metal required for a bridge amounting to 20% less than if wrought iron were used. Mr. Thompson claims that much of the material now sold under the name of "steel," while it will withstand so-called "tests," will not endure the test of time and traffic, and states that a considerable number of cases of actual and incipient failure should lead to more caution in the acceptance of steel for railway bridges. We have commented on this specification in our editorial columns.

Materials for Steel Bridges.

1. All of the materials used in the manufacture of the bridges shall fully and strictly conform to the several specifications as follows: (A) specifications for raw materials; (B) specifications for ingots; (C) specifications for rolled steel.

2. The materials used in the manufacture of bridges shall be made from the raw materials to the finished product at one establishment.

3. The finished material shall not be shipped from the rolling mills until the inspector of rolled steel has duly accepted and marked the same.

4. The consulting engineer reserves the right to reject all the steel from any special cast that has passed the requirement of three specifications above enumerated, provided, however, that three out of five specimens selected at random by him, from material rolled from said special cast, shall show evidence of "piping," or lamination.

5. Materials for steel bridges shall be ordered upon bills approved by the consulting engineer. The contractor shall submit in triplicate from complete, correct and legible bills, exhibiting the order numbers, name or number of bridge covered by the order, giving the location of the furnaces and mills where the ingots are cast and the steel is to be rolled. Should the consulting engineer approve the bills, two copies shall be retained by him and one returned to the contractor.

6. The consulting engineer reserves the right to make such analysis, examinations, etc., on ingots and finished material, either physical or chemical, as he deems necessary to arrive at a thorough knowledge of the solidity of the ingots or the physical or chemical character of the rolled product; and the contractor shall furnish such pieces of identified finished material for examination as the consulting engineer may require.

7. The consulting engineer reserves the right to mark all rejected finished material with a permanent mark of identification.

8. The expense of inspection of the raw materials, the inspection of ingots, and the inspection of rolled steel, including the record and identification of the same, together with the cost of chemical and occasional microscopic work, shall be borne by the contractor. The inspectors shall be appointed by the consulting engineer.

9. These specifications throughout are subject to the interpretation of the consulting engineer.

Specifications for Raw Materials Used in the Manufacture of Steel for Ingots.

1. All raw material used in the manufacture of steel ingots shall be chemically within the Bessemer limit of the following proportions of 1%: Sulphur, 0.05; phosphorus, 0.10; copper, 0.40.

2. All raw materials shall be subject to the acceptance or rejection of the inspector of raw materials.

3. The contractor shall furnish to the inspector of raw materials complete and correct reports of all raw materials to be used in every heat prior to charging the same into the furnaces.

4. The inspector of raw materials shall have free access at all times to all stock piles and other stores of raw materials, and the contractor is to furnish said inspector all reasonable data and facilities to assist him in the inspection and identification of all raw materials.

5. Rejected raw materials shall not be used in the manufacture of ingots.

Specifications for the Manufacture of Ingots.

1. All ingots must be cast from steel melted in an acid lined open hearth furnace.

2. The ingots shall be subject to the acceptance or rejection of the inspector of ingots.

3. No single ingot or casting shall (in order to avoid extreme segregation) exceed 15,000 lbs. in weight.

4. All ingots must be bottom cast.

5. No ingot shall be disturbed or removed from the position in which it is cast until it is sufficiently solidified to obviate "bleeding."

6. All ingots shall be duly marked for identification, and a complete and correct report of each cast, giving the number, size and weight of each ingot, shall be furnished by the contractor to the inspector of ingots within five hours after the cast is made; and the contractor shall furnish said inspector such further data as he may require to assist him in keeping the record of the identity of the ingots.

7. The inspector of ingots shall have free access at all times to the works where the ingots are cast.

Specifications for Rolled Steel.

1. Steel shall be rolled only from identified and duly accepted ingots.

2. Finished rolled steel shall show under analysis not more than the following proportions of 1%: Phosphorus, 0.08; sulphur, 0.04; manganese, 0.45; copper, 0.20.

3. All finished rolled steel shall be straight, well finished in the rolling, full to dimensions and free from laminations, buckles, surface, edge or other defects.

4. All finished rolled steel shall possess certain definite physical properties which shall be determined by the inspector of rolled steel from such test pieces (to be prepared by the contractor) as said inspector shall determine, as follows:

	Not less than lbs. per	Not more than sq. in.
Ultimate tensile strength plates and shapes	58,000	65,000
Ultimate tensile strength rivet rod	50,000	54,000
Elastic limit plates and shapes	38,000	....

Elongation plates and shapes under 36 ins. wide, 26% in 8-in. length.

Elongation plates over 36 ins. wide, 24% in 8-in. length.

Reduction of area plates and shapes, 50%.

Reduction of rivet rod, 60%

5. The fractures of test pieces shall be mainly fine grained.

6. Finished rivet rod when heated to a red heat and upset for 3 ins. of metal shall show (upon cutting out) a silky fracture.

7. Strips of finished material cut along the direction of rolling shall withstand cold bending, double upon itself under the hammer without visible cracking.

8. Prepared specimens cut from finished material at random shall show no "piping."

Instructions to Inspectors.

1. The inspector of rolled steel will take general charge of inspection, appointing the inspector of raw materials and the inspector of ingots. He will examine and check all orders, shipments, reports, tests and other examinations, etc. He will record all rejected raw material, ingots and rolled steel and notify the contractor of the causes for rejection of the same.

2. The inspector of rolled steel will direct the work of the inspector of the raw materials and see that he is very familiar with the several grades of raw material in current use at open hearth furnaces; that he makes inspections personally; and that he identifies inspected raw materials; that he is on duty day and night when required; and that he turns over to the inspector of ingots a correct certificate and record of all identified raw materials accepted or rejected by him.

3. The inspector of rolled steel will direct the work of the inspector of ingots and see that he is familiar with the work of the furnaces, the uniformity of the product, etc.; that he traces the raw materials to the charging of the same into the furnaces and thence to the ingots, and thence to the mills, reporting the same to the inspector of rolled steel; that he is on duty day and night when required; that he rejects "bled" ingots or ingots not bottom cast; that he notes especially casts that have been too violently or quickly melted or burnt, and that he reports the same for special examination of steel rolled therefrom.

4. The inspectors of rolled steel personally will inspect the rolling of material only from traced ingots, and he will from time to time test for the properties, chemical and physical, called for under the specifications for rolled steel. He will be on duty at all times required.

5. The inspector of rolled steel shall establish and assign a value to all rolled steel inspected by him, and shall then record this value. Rolled steel which has been accepted by him as satisfying all the requirements of the specifications for rolled steel traced to accepted raw materials and ingots shall have an assigned value of 100.

Rolled steel which, more or less, fails to meet the requirement of the three specifications shall have an assigned value ascertained by the following rating:

For steel traced to accepted raw materials	15
" " " " " ingots	15
" " satisfying clause 2d specifications rolled steel	10
" " satisfying clause 3d specifications rolled steel	10
" " satisfying clause 4th specifications rolled steel	30
" " satisfying clause 5th specifications rolled steel	10
" " satisfying clause 7th specifications rolled steel	10
Total	100

In which Clause 4th is divided into:

Ultimate strength	5
Elastic limit	15
Elongation	5
Reduction of area	5

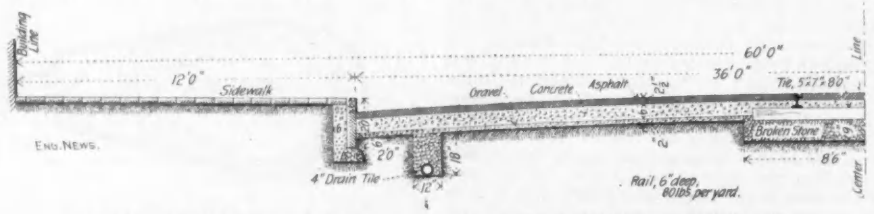
6. The inspector of rolled steel will accept all steel valued at 100 and reject all steel of less value.

7. The inspector of rolled steel will not accept satisfactory testing machine results as conclusive evidence of the quality of the steel inspected further than its rating of 30; machine tests are to be considered as corroborative only, and of no value considered alone. All of the requirements of the specifications must be satisfied and the whole taken together shall be the absolute criterion establishing the value of the steel before acceptance.

(". . . . . any test is liable to yield untrue results, either from incapacity or carelessness in those who use it.")—Herbert Spencer.

ASPHALT PAVEMENT AT MUNCIE, IND.

Plans for a very substantial system of street paving construction with asphalt pavement have been prepared by Mr. Wm. H. Wood, City Civil Engineer of Muncie, Ind., and the arrangement is shown in the accompanying sketch. The city has awarded the contract for the construction of 30,000 sq. yds. of standard Trinidad asphalt pavement to the Warren-Scharf Asphalt Paving Co., of New York, at $2.76 per sq. yd., including the excavation, the construction of the subsoil drains, 3 ins. of gravel upon the subgrade, 6 ins. of concrete, and 2½ ins. of asphalt wearing surface. The work is guaranteed for five years, for the same bid. Where there are street car tracks, the contractor puts in the foundation and ballasts the track to grade and line, furnishing the necessary material, while the railway company furnishes the rails, ties, splice bars, bolts, etc., and spikes the rails to the ties. The contractor gets $2.16 per ft. of track for the foundation and wearing surface between the rails. The roadway is 36 ft. wide, with 12-ft. sidewalks. The subdrain at each side is of 4-in. drain tile laid in a trench filled with broken stone, and the stone curbing is 6 ins. thick and 20 ins. deep, resting on broken stone and backed by concerte. Under the track the roadbed is excavated 9 ins. deep for a width of 8 ft. 6 ins., its travel being filled with broken stone to the level of the concrete. The ties are 8×7 ins., 8 ft. long, and the girder rails are 6 ins. deep, weighing 80 lbs. per yd.



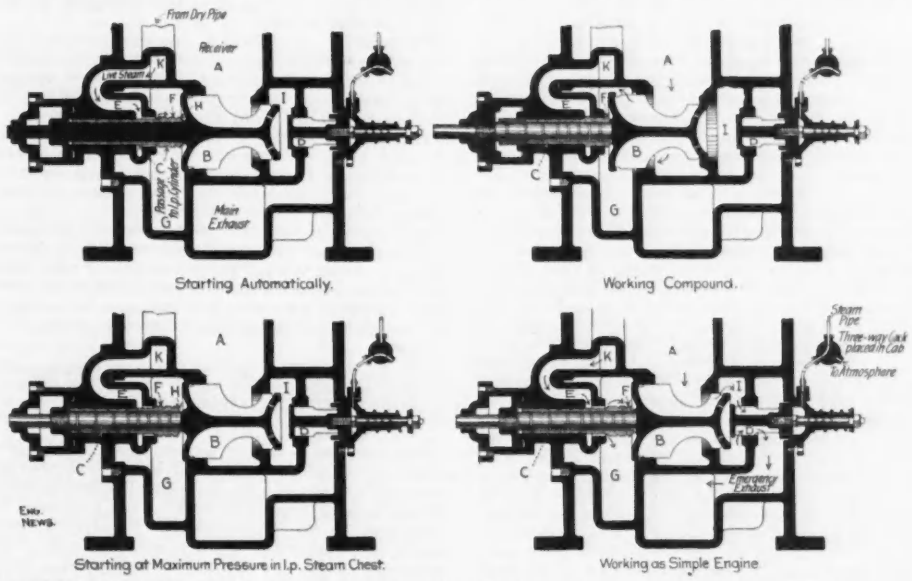
CROSS-SECTION OF STREET WITH ASPHALT PAVING; MANCIE, IND.

A sidehill viaduct and a tunnel carried on an arch are two singular pieces of work carried out on the Lons-le-Saunier & Champignole Railway, in France. The line ascends the slopes of the Jura Mountains, cutting through unstable and wet strata, which necessitated enormously heavy works for drainage and to prevent slides. On some sidehill work it was found that the cut and bank would not stand, and a viaduct or "arcade" was built of masonry, the parapet of the upper side of the structure being against the slope. One of the tunnels encountered a large cavern, and it was necessary to throw an arch across this to carry the invert and the foot of one of the tunnel walls, the other wall resting on the rock.

INTERCEPTING VALVE FOR COMPOUND LOCOMOTIVES.

In our issue of May 10 we described and illustrated the compound locomotive built by the Richmond Locomotive & Machine Works, of Richmond, Va., and we present herewith the drawings of the patented form of intercepting valve, showing the valve in different positions.

The drawings show sections through the low-pressure cylinder saddle, with the valves in their various relative positions. The high-pressure cylinder exhausts into the receiver, which is placed inside the smokebox, and opens into the chamber A. The intercepting valve, as shown at B in the several views, has a piston on its forward end, which acts in its cylinder as an air dash-pot, to prevent any slamming of the valve. Around the stem of this valve is a sleeve, C, which has an axial movement on the stem and acts as an admission and reducing valve to the low-pressure cylinder when starting and when working simple. Valve D is a plain winged valve with a piston on its rear end, and is called the emergency valve, as by its use the engineman can, at will, operate the engine as a simple engine. When starting, steam from the boiler goes to the high-pressure cylinder in the ordinary way and also to the port E, through a 2-in. steam pipe connected to the dry pipe. There is then no pressure in the receiver A, and the pressure on the shoulder F of the sleeve C moves the sleeve and valve B to the right, closing the receiver, and letting steam past the shoulder F into the low-pressure valve chest, G.



Starting Automatically. Working Compound.

Starting at Maximum Pressure in l.p. Steam Chest. Working as Simple Engine.

INTERCEPTING VALVE FOR COMPOUND LOCOMOTIVE; Richmond Locomotive & Machine Works.

As the area of the end, H, of the sleeve C is, say, twice that of the shoulder F, half of the boiler pressure will move the sleeve C to the left, cutting off steam from port E, and thus equalizing the work in both cylinders. After, say, 1½ revolutions, the pressure accumulates in the receiver A and moves the valve B to the left, carrying the sleeve with it, when, the steam being permanently cut off at E, there is a straight connection between the two cylinders. In starting on grades, or when exerting maximum power, the engineman can move the three-way cock in the cab, admitting live steam from the boiler behind the piston on the emergency valve D, and holding it open against its spring. This exhausts the small cavity I, in which the pressure is equalized with the receiver through holes in the valve B, and then the valves B and C move instantly to the right, assisted by steam pressure on the shoulder F. The high-pressure cylinder has now a separate exhaust, and the low-pressure cylinder gets its steam direct from the boiler through the port K and reducing valve C. Except when working simple the valves act entirely automatically. The lubricator to the low-pressure cylinder enters port K, and thus ensures constant lubrication to the intercepting and reducing valves.

Owing to the small area of port E and the contracted exhaust through D, the engine develops less power as a simple engine than as a compound, at a speed of over, say, five miles an hour, and thus the engineman is compelled to work compound.

Should either side break down, the emergency valve can be opened and the engine brought in on one side like an ordinary engine.

THE NIAGARA FALLS POWER PLANT.

With reference to the article, descriptive of the works at Niagara Falls, in our last issue, we have received from Mr. Geo. B. Burbank, M. Am. Soc. C. E., under whose direction, as chief engineer, the works were constructed, a few additions too late for incorporation in the original article, and therefore give space to them here. As originally planned, the canal conveying the water from the river above the falls to the power house was to be about a mile in length, extending parallel with the river, as shown on the map in our issue of Jan. 23, 1892. This has now been definitely abandoned, and only the lower portion of the canal, forming an inlet from the river, about 1,500 ft. in length, has been constructed. This will supply sufficient water to generate 100,000 HP. and utilize the full capacity of the tail-race tunnel. The cofferdam built at the mouth of this canal, prior to its excavation, was about 390 ft. long, and its ends were connected with the shore by clay embankments, each about 650 ft. in length.

The rock, in which the tail-race tunnel was excavated, is a limestone with slaty seams for about 1,200 ft. of the distance and the remainder is a compact shale which underlies the Niagara limestone at a depth of about 130 ft.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Diligence Must be Exercised to Set Aside Surveys.

In the case of Halstead v. Grinnan, recently before the Supreme Court of the United States (14 Supr. Ct. Rep., 641), it was sought to set aside a survey which had stood unchallenged for over 25 years. Such a long delay, the court said, suggested laches. The length of time during which a party neglects the assertion of his rights which must pass in order to show laches, varies with the peculiar circumstances of each case, and is not, like the matter of limitations, subject to an arbitary rule. There must, of course, have been knowledge on the part of the plaintiff of the existence of the rights, for there can be no laches in failing to assert rights of which a party is wholly ignorant, and whose existence he had no reason to apprehend. But he should have used reasonable diligence to have informed himself of all the facts. In this particular case, the court found that the plaintiff was guilty of laches, and therefore not entitled to any relief. There was in a deed made to a corporation, of which he was a stockholder, 25 years before the commencement of the suit, a provision for a survey, and in the deed to himself, made more than 20 years before the suit, was a declaration that the survey called for by the previous deed had been made. When, therefore, he took title, he took it with notice that a survey had been made, and would not so long afterward be heard to say that he had no knowledge of that fact.

Actual and Agreed Boundaries.

The Supreme Court of Florida holds, in the recently decided case of Watrous v. Morrison (14 Southern Reporter, 805), that in the sale of land in sections or subdivisions thereof, including lots, according to the government survey, the survey as actually made controls. It is the survey as it was actually run on the ground that governs, if the monuments, corners, or lines actually established can be located or proved. Courses and distances yield to such corners or lines so long as the latter can be located, and for the reason that the latter are the fact or truth of the survey as it was actually made, while the former are but the description of the act done, and, when inaccurate, they cannot change the fact. Mere agreement between owners of contiguous lands to employ a common agent or surveyor to run a line and set up boundaries between two adjoining properties, where the dividing line is susceptible of being correctly located, will not estop either party or the guarantees of either, from showing an error in such line. But where the boundary between contiguous lands is uncertain or disputed, the owners of such lands may agree upon a certain line as the permanent boundary line; and, where the agreement is followed by actual occupation according to such line as the boundary, the line will be binding upon them and their successors in title as the boundary. The line becomes binding for the reason that the proprietors have by such consent and conduct agreed permanently upon the limits or extent of their respective lands or property. It is not necessary that an agreement to settle an uncertain or disputed line shall be made after the line has been fixed. For example, parties may agree orally to have an uncertain or disputed line run, and that it shall be the controlling line; and if they afterwards treat it as the permanent dividing line by improving up to it, or otherwise, they will be confined to that line.

Validity of Assessments for Public Improvements.

By an act of the assembly of Pennsylvania passed March 23, 1866, it authorized and required the city of Philadelphia to occupy Broad St. for its entire length, and to pave the street in such manner as the councils should think best, and authorized the city to enact ordinances requiring the cost of the improvement to be paid by the owners of property abutting on the street. Where one, being an owner of property on the street, refused to pay his assessment, the city sued him for the amount and recovered judgment in the court below, which was reversed by this court, Mr. Justice Sharswood delivering the opinion and conceding the right of the legislature to grant to municipal corporations the power of assessing the cost of local improvements upon the properties benefited, held that where an owner's property had been once assessed for the cost of an improvement, it could not be again assessed for a second improvement of the same character, and that any law granting such a right to the municipality was unconstitutional and void. He said: "There is no case to be found in the state, nor, as I believe, after very thorough research, in any other, with limitations in the constitution or without them, in which it has been held that the legislature, by virtue merely of its general powers, can levy or authorize a municipality to levy a local tax for general purposes. In truth, it matters not whether an assessment upon an individual or a class of individuals for a general and not a mere local purpose be regarded as an act of confiscation, a judicial sentence or rescript, or a taking of private property for public use without compensation. In any respect it transcends the power of the legislature and is void. Whenever a local assessment upon an individual is not grounded upon and measured by the extent of his particular benefit, it is, for so much, a taking of his private property for public use without any provision for compensation. The original paving of a street brings the property upon it into the market as building lots. Before that it is a road, not a street. It is, therefore, a local improvement with benefits almost exclusively peculiar to the adjoining properties. Such a case is clearly within the principle of assessing the cost on the lots lying upon it. But when a street is once opened and paved, thus assimilated with the rest of the city, and made a part of it, all the particular benefits to the locality derived from the improvements have been received and enjoyed. Local assessments can only be constitutional when imposed to pay for local improvements clearly conferring special benefits on the properties assessed and to the extent of those benefits. They cannot be so imposed when the improvement is either expressed or appears to be for general public benefit."—Digest of case of Morewood Ave. (Sup. Ct. of Pennsylvania, 27 At. Rep., 123).

PERSONALS.

Mr. J. R. Meredith, civil engineer, died at Pittsburg, Pa., May 23.

Mr. James H. Barrett, General Superintendent of the Buffalo, Rochester & Pittsburg Ry., has resigned.

Mr. P. N. Leff, Chris. Dinton and Ludwig Holdman, three American mining engineers, are reported to have been murdered near Nacory, Chihuahua, Mexico, by a band of Yaqui Indians.

Mr. C. M. Stanton, Division Superintendent of the Ohio & Mississippi Ry., has been appointed General Manager of the Jacksonville, Louisville & St. Louis Ry., with headquarters at Jacksonville, Ill.

Mr. J. P. O'Donnell, M. Am. Soc. C. E., the English expert on railway signaling, arrived last week from London. He will present a paper on the block system at the annual convention of the American Society of Civil Engineers at Niagara Falls in June.

Mr. Robert H. Ricker, whose death at Weeping Water, Neb., on May 17, was noted last week, was an engineer of wide experience. He was born at Portland, Me., and entered the railway service in May, 1845, as Assistant Engineer on the survey and location of the Atlantic & St. Lawrence Ry. In 1846 he was Assistant Engineer on the Essex Ry. from Salem to Lawrence, Mass.; in 1847 was in charge of location of the Portsmouth & Concord Ry.; in 1849 was in charge of surveys, location and construction of the Great Falls & Conway Ry. In 1850 he was Assistant Engineer of the Kennebec & Portland Ry., and also in charge of location and construction of an extension from Yarmouth to Portland, and in 1851-'52-'53 was principal Assistant En-

gineer of the Rochester & Syracuse Air Line. In 1855 he located the present White Mountain carriage road, and was in charge of its construction; in 1854 and 1855 was in charge of surveys and location of the Utica & Binghamton Ry.; from 1856 to 1858, was Chief Engineer of the Detroit, Monroe & Toledo Ry. and Division Superintendent; and from 1859 to 1861 was Superintendent and Engineer of the Louisville, New Albany & Chicago Ry. From 1862 to 1866, he was Superintendent and Engineer of the Terre Haute & Indianapolis Ry., and during the war was superintendent of military transportation for the state of Indiana. In 1867 he was Superintendent of Motive Power of the Pennsylvania Ry.; from 1868 to 1876 was Superintendent and Engineer of the Central R. R. of New Jersey; and in 1877 and 1878 was engaged in the railway supply business. From 1881 to 1884 he was General Manager of the Gilbert & Bush Car Works, Troy, N. Y. In 1885 and 1888 was General Superintendent and Chief Engineer of the Denver & Rio Grande Ry.; and from Feb. 1, 1888, until June, 1893, was General Superintendent of the St. Louis, Iron Mountain & Southern Ry.

NEW PUBLICATIONS.

PROGRESS IN FLYING MACHINES. By O. Chanute, C. E. New York: The American Engineer and Railroad Journal. 8vo; pp. 308; 87 cuts; $2.50.

The fact that the cover of this book is ornamented by a gold-leaf reproduction of a photograph of a man (Mr. Lilienthal) in the very act of successful flight, which was many times repeated over courses rising to several hundred yards and at very considerable heights, aided by artificial wings alone, shows that such a book as this it decidedly timely; and although it must be admitted that nothing which has yet been done can in any broad and practical sense be pronounced a success, yet enough has been accomplished by three or four experimenters to establish beyond all reasonable doubt that, as the author expresses it, "with our present mechanical knowledge and appliances, men may reasonably hope eventually to fly through the air." They may never actually do it, except to the limited extent that they have already, but enough has been done in the last ten years to prove almost to demonstration that all that is lacking is the skill—a great lack, but one which we may reasonably hope to supply. It is certain therefore that the problem will hereafter, much more than heretofore, attract the attention of earnest and able men who are quite certain to persist in studying it in sufficient numbers to insure a slowly or rapidly increasing measure of success. The greatest recent gain has been the general recognition of the fact that the best flying birds exert no unusual amount of muscular power, and the kinds which man is most likely to imitate none at all, except for guidance. Mr. Lilienthal's actual successes have enforced this lesson in the most practical possible way, so that it is now generally admitted that in order to fly through the air man needs no new senses nor powers nor machines, but only a little more experience and skill.

We are therefore just upon the threshold of a new era in the study of this problem, and this is therefore in one sense a favorable time to publish a work of this nature, which purports to give, so far as possible, a critical summary of all that has been either attempted or accomplished in this direction to date.

Nevertheless, the paucity of our present knowledge of this subject is strongly brought out by the fact that it should be possible within the covers of one small book to give a tolerably full account of every effort, good, bad or indifferent, sensible or foolish, which man has made in this direction in all the centuries of the past. Of course there are some omissions, but the author has been greatly aided in collecting these records by various French authors to whom he gives due credit, while he has also gathered all he could himself, as, for instance, from the United States patent records, and there cannot be much of record relative to the art of flight which is not abstracted in this volume. Supposing a man were to try to record the history of the steam engine or locomotive or churn or sewing machine with equal fulness, to what dimensions would his volume not expand? It would be so voluminous that it would defeat its purpose, and it is evident also that a large part of it would be worse than wasted space for any one trying to master the subject as an art, though for merely historical purposes it might have a certain value.

The same is true beyond doubt of three-quarters or more of the records given in this volume, which record nothing more than efforts foredoomed to failure because of obvious imperfections of method; but the difficulty is that in the present state of the art, though we can see that many of these efforts were hopelessly imperfect, we cannot see which of these were most in the direction of success, because there is as yet no accepted theory of the art. Therefore, unless the author was to rely on his private judgment to an unwarranted extent, there was no resource for him but either to wait until the art was more fully developed, or to show a broad impartiality in recording all actual efforts. He has chosen the latter course and it is fortunate that he and his French coadjutors did so in one respect at least; the full history of the art is now recorded. Had this not been done before the precise line of success had been fully marked out, it is probable that this might never have been done, except in regard to efforts found to lie in that line, and therefore that a very interesting chapter of human history might never have been recorded.

Nevertheless, it follows from these facts that it is as a history rather than a treatise that this work is to be studied, and it is in that spirit that the author has written it. He is extremely guarded in his criticisms, and still more guarded in his statements of conclusions. In fact, it may almost be said as to the latter that he gives none at all, except as to the broad fact that man may reasonably hope to master the art of flight. He bases this conclusion largely on the fact that soaring birds do actually fly with little or no exertion by taking power from the wind, and that man has actually imitated them to some extent. But as to just how birds soar the author professes himself doubtful, and dissatisfied with all the explanations so far offered. Being doubtful as to this fundamental fact, he naturally must be still more doubtful as to just how man will imitate them, and therefore very guarded in his statements of opinion while broadly inclusive in his records of facts. It is a great service to science to have had the task carried out in this spirit and so completely, and as we cannot doubt that the art of flight will at some future day assume much practical importance, we apprehend that this work will hereafter occupy an important place in technical literature as a landmark of progress.

That any one of its many engravings shows an apparatus bearing any close resemblance to the successful flying machine of the future, we do not believe; and neither do we believe that the most successful machine of this nature so far tried, that of Mr. Lilienthal, bears the closest resemblance to the machine which will win practical success. It is now generally recognized that the discovery of the art of ballooning in 1783, though at the time it was hailed as the beginning of successful navigation of the air, was really an obstacle to that end, by diverting man's efforts in a false direction. It seems to us more than probable that Mr. Lilienthal's efforts, which may be described as an attempt to convert man into a soaring bird by providing him with artificial wings and tail, will have the same effect. As it seems to us, man may build birds, but he will never be one. Physiological reasons and the struggle for existence have limited the size of birds, but the best flyers are the larger birds, and all the analogies of nature seem to us to indicate that man's strongest hope of success, if he is to succeed at all, lies in air-ships bearing a close general resemblance to the outward form and structure of the bird, but very much larger, and large enough to contain two or more men within them in a closed chamber.

With this construction speeds of 100 or even 200 miles an hour become physically possible, whereas an exposed man cannot move through the air with safety faster than 30 to 40 miles per hour; and it is quite certain that the faster the speed the easier the problem of sustention. This, however, is not the place to enter into any discussion of the general problem. We enter into it so far only to say that if any one reads this work with the idea that anything contained in it will give him a clear idea of what the future flying machine is to be, he will be disappointed, but if he reads it only with an idea of finding out on what grounds so many men have come to feel confident that the art of flight is now within the powers of man without awaiting any further progress in other arts, he will find it nearly all in this book, and very cleverly and clearly put, though he will have to work harder than he otherwise would, because the author has so cautiously left to each reader the task of winnowing the experimental chaff from the wheat. In a certain important sense nothing is chaff which records actual efforts in this direction, and in the present state of the art. As is usual in works otherwise well done, the work is accompanied by an admirable index.

REPORT OF THE MASSACHUSETTS BOARD OF RAILWAY COMMISSIONERS. — Boston, Mass. Secretary, W. A. Crafts. 8vo; pp. 600.

The total extent of the railways in the state of Massachusetts at the end of June, 1893, was 2,119 miles, comprising 4,151 miles of track. Of the total revenue 50.16% was from passengers, 48.44% from freight and 1.40% from other earnings. The average passenger fare per mile was 1.83 cts., and the average freight rate 1.39 cts. per ton-mile. Two important consolidations during the year were the lease of the Old Colony R .R. system, of 576 miles, to the New York, New Haven & Hartford R. R., for 99 years, with a guaranteed dividend of 7% on the Old Colony R. R. shares; and the lease of the Connecticut River R. R. to the Boston & Maine R. R., for 99 years, with a guaranteed dividend of 10%, which the report considers as "an extreme, not to say an excessive, dividend rate to guarantee on the stock of any railway company for a century to come." There were nine train accidents, all collisions, in which 13 persons were killed and 45 injured. The system of inspection and supervision of railway bridges has been ably carried on by Prof. Geo. B. Swain, and the board has now complete records of the plan of construction and present condition of each railway bridge in the state. Prof. Swain's report states that on the Boston & Maine R. R., and the New York, New Haven & Hartford R. R., the oversight of all bridges has been transferred from the chief engineer or bridge engineer to the division superintendents. There are now 1,698 railway bridges of over 10 ft. span in the state, and 48 new bridges were erected during 1893, 15 being new bridges where none existed before and 33 being bridges rebuilt. Interesting experiments made with red and white lights carried by flagmen showed that when both were exhibited together the former could not be seen at 600 ft. unless held in front of the white, and the conclusion arrived at was that if it is necessary to carry a white light it should not be carried in the same hand as the red light, and should be concealed when the flagman is swinging the red light. In the work of removing grade crossings during the year, $1,439,912 was expended. The most extensive undertaking in this department now in contemplation is the abolition of crossings on the Boston & Providence R. R. in Boston. The gross assets of the companies on June 30, 1893, were $334,724,845, with gross liabilities (including capital stock), of $320,551,031.

The report on street railways shows a total length of 874 miles, including double track, but not including 63 miles of siding. Of this total 771 miles were operated by electricity and 163 by horse-power. This part of the report was abstracted in our issue of Feb. 15.

Two railway accidents are specially reported upon; the first being the collapse of the Boston & Albany R. R. bridge at Chester, Mass., under a train, on Aug. 31, 1893, the bridge being then under repair. This accident has been fully described and discussed in our columns. The conclusion is as follows: "If there had been a sufficient trestle the train would have passed safely over the bridge. If instead of a trestle there had been a competent inspector, the train would have been stopped." The other accident was the collision on the Old Colony R. R., near Leominster, Mass., Feb. 6, 1893.

INFORME SOBRE EL SISTEMA DE SANEAMIENTO POR MEDIO DE LAS SOLUCIONES DE CLORUROS ELECTROLIZADOS, que Presenta Al H. Ayuntamiento el Ingeniero Roberto Gayol. Mexico. 8vo; pamph.; pp. 51.

This pamphlet is a very earnest presentation of the merits of the Hermite system of water purification by electrolysis of sea water, or an artificial imitation thereof, which, according to the author, was introduced in New York by the "Woolf Electric Disinfecting Company" as the invention of Mr. Albert E. Woolf. More accurately stated, the Woolf Co. constructed a plant for sewage and another for purification at Brewsters, N. Y., in the Croton watershed, last year, as fully recorded in Engineering News of July 13 and 27, 1893. Mr. Gayol was commissioned by the city government of Mexico to come to the United States and investigate the whole question of water supply and water and sewage purification, which he appears to have done with much care. He states that he was greatly impressed with the so-called "Woolf system," but found after investigation, that it was nothing more than the system introduced by M. H. Hermite in Rouen, in 1889. Mr. Gayol, on returning to Mexico, made some experiments, aided by sundry Mexican scientists, which confirmed all his previously gathered information, and as a consequence he presents all the facts in this report, which ends with an application for an appropriation of $3,000 in order that the process may be put into experimental use on a considerable scale, Mr. Gayol urges that the process is especially suitable to Mexico, on account of the poor sanitary condition of many of its towns, especially along the coast, and the badness of the water supply in many cases. In our issue of March 22, 1894, there was published a paper on "The Electrical Purification of Water," by Prof. Thos. M. Drown, and in the same issue brief editorial comment was made on the same subject.

PATENT-OFFICE MANUAL: Including the Law and Practice of Cases in the United States Patent Office and the Courts Holding a Revisory Relation Thereto. By Geo. H. Knight, Author of "Relation of Invention to the Conditions of Life," Member of the Patent-Office Bar Association. Boston, Little, Brown & Co. 8vo; law sheep; pp. 655; $5.

The author of this treatise describes it modestly in his preface as a convenient summary of the more important rulings governing proceedings in the Patent Office up to the time of going to press. With the exception of a brief introductory chapter on the patent franchise, the book consists of a digest alphabetically arranged, of the decisions relating to patents for inventions and designs and to trademarks and labels, with appendices referring to copyrights and foreign patents. A feature of the book is that a large part of the decisions quoted are of recent date.

For the engineer who has occasion to post himself in patent law we know of no more useful manual than

this book. In fact, a thorough familiarity with the contents of this volume, together with Renwick's "Patentable Invention," reviewed in these columns not long ago, and the "Rules of Practice," published by the office, should enable an engineer to form an intelligent opinion concerning the ordinary questions relating to patents which arise in his practice. The only fault we have to find with the book before us is that there is no index to the digest of decisions, and the unprofessional reader will find it difficult to know under exactly what title to look for information concerning a given matter. This is so serious a fault that it should be remedied in future editions.

CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS: Proceedings at the Spring Meeting, Held at New Britain, Conn., May 31, 1893, and at the Tenth Annual Meeting, Held at Hartford, Conn., Jan. 9, 1894. A. R. Wadsworth, Farmington, Secretary and Treasurer.

The papers included in this report are as follows: "Methods of Duplicating Drawings," by Elgar Clark. "Sanitary Progress in Massachusetts in Water Supply and Sewerage," by Frederic P. Stearns. "Water for Domestic Uses," by Prof. T. M. Drown. "Description of the New Dam of the New Britain Water-Works Reservoir," by Percy M. Blake and remarks on the same subject by T. H. McKenzie. "The New Works for an Increased Water Supply for the City of Waterbury," by Mr. R. A. Cairns. "The Failure of a Dam and How It Was Repaired," by A. R. Wadsworth. "Shop and Mill Construction," by B. K. Field.

SOUTH AUSTRALIA PUBLIC WORKS: Report of the Public Works Department for the Year Ending June 30, 1893. F. W. Holder, Commissioner; Alex. B. Moncrieff, Engineer-in-Chief, Adelaide, South Australia. 4to; pp. 93; tables, folding sheets of diagrams and map.

Water and irrigation works, the sewerage system of Adelaide, jetties and harbors, roads and bridges are covered by this report. A number of water-works and irrigation systems are under the control of the department, and for these financial and other statements are made. The balance sheet of the sewage farm shows a small profit above all expenses, including interest. Sections of a number of artesian wells are given and a large map showing the public works under the charge of the chief engineer.

ENGINEERING RESULTS OF IRRIGATION SURVEY: By Herbert M. Wilson. Extract from the Thirteenth Annual Report (1891-2), of the U. S. Geological Survey, J. W. Powell, Director. Pub. Doc. 4to; pp. 375; 71 plates and 85 figures in the text.

This volume is divided into two parts, "American Irrigation Engineering" and "Engineering Results of Irrigation Survey." The first part describes many important irrigation works constructed in this country, and the second is devoted principally to a description of possible reservoir sites and canal lines. The illustrations are chosen with discretion and well printed, many of the half-tones being very pleasing.

MUNICIPAL ORDINANCES.—City of Louisville, Ky. 12mo; pp. 118; Illustrated.

This little book contains the general ordinances concerning the improvement of streets, alleys, sidewalks and cisterns, being practically specifications for the work, with typical cross-sections, etc. Between the several ordinances are blank sheets of cross-section paper for memoranda, but it would have been better to have numbered the pages consecutively instead of giving a separate paging to each ordinance.

TRADE PUBLICATIONS.

BLOWERS: Connersville Blower Co., Connersville, Ind. 8vo; pp. 16; Illustrated.

Besides illustrations of different arrangements of cycloidal blowers driven by steam and electricity, this pamphlet contains cuts of the cycloidal planer used in planing the impellers, and of the adjustable journal box with which all the company's blowers are fitted.

SKYLIGHTS.—Valle & Young, Baltimore, Md. 8vo; pp. 28; Illustrated.

This is a descriptive catalogue of the firm's system of fire and waterproof skylights made without putty, with illustrations of different applications of the system, and half-tone views of buildings to which it has been applied.

STEAM PUMPS: The Marsh Steam Pump for Handling the Hot Water of Condensation from Clarifiers, Dry Kilns, etc. Battle Creek Machinery Co., Battle Creek, Mich. 8vo, paper; pp. 32; Illustrated.

This pamphlet describes and illustrates the pump made by the above company and the uses to which it may be put.

TURRET LATHES: Gisholt Machine Co., Madison, Wis. 8vo, oblong; pp. 12; Illustrated.

This is the first of a series of monthly pamphlets to be issued by this firm, giving illustrations of the wide range of the use of this company's turret lathes. Four machines are illustrated by handsome half-tone prints.

CATALOGUE OF ENGINEERING, SURVEYING AND SCIENTIFIC INSTRUMENTS. Mahn & Co., St. Louis, Mo.

The name of this well-known firm was incorrectly printed in noticing its recently published catalogue in our last issue. The correct spelling is that given above.

SOCIETY PROCEEDINGS.

AMERICAN STREET RAILWAY ASSOCIATION.—The annual meeting will be held at Atlantic, Ga., on Oct. 17, 18 19. The machinery hall of the Piedmont Exposition Co. has been engaged for two weeks for the exhibition of street railway supplies and manufactures. Particulars as to the convention and the exhibition can be obtained from Mr. W. J. Richardson, Secretary of the Association, 166 Montague St., Brooklyn, N. Y.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—The regular monthly meeting was held on May 17. The discussion of Mr. Thos. H. Johnson's paper on "The Theory of Dynamic Work Applied to Static Forces," was continued with much animation, several members taking part, and Prof. Mansfield Merriman's views on the subject were presented in a paper prepared and forwarded by him. A very interesting paper on "Smoke Prevention by the use of Producer Gas," by Mr. Bauvelt, of Philadelphia, was read by Mr. White, and elicited considerable discussion. A paper on "The Determination of Arsenic in Lead Base Bullion," was presented by Mr. John E. Williams, at the meeting of the Chemical Section, which was held on Friday, May 18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Arrangements are completed for the summer meeting of the society at Montreal, to be held next week, and a large attendance is anticipated. A special excursion train is to leave New York city at 9:40 a.m., June 4, and will run through to Montreal over the Hudson River, Fitchburg, Central Vermont and Grand Trunk railways. Special cars from Boston will join the main excursion at Montreal. A round trip rate of $13.35 has been secured from New York to Montreal, and it is expected that the party leaving New York will number over 100. The excursion will be in charge of Mr. A. W. Ecclestone, Southern Passenger Agent of the Central Vermont R. R., from whom full information can be obtained.

ENGINEERING ASSOCIATION OF THE SOUTH.—By special invitation a party of members boarded the steamer "Colbert" at Decatur, Tenn., on May 12, to inspect the Mussel Shoals Canal. After passing through the Elk River Shoals Canal and inspecting the locks at that point, the boat passed on to the head of the Big Mussel Shoals Canal, where the party disembarked and proceeded by train on the 48-in. gage track used in towing the boats through the canal by locomotives. Stops were made at all locks, bridges, aqueducts or other places of interest, and on returning a stop was made at the aqueduct, the water having been withdrawn, affording a view of its construction. A stop was also made at the great dredge, which was in full operation, lifting the silt up with an endless chain of buckets and sluicing the same through a long pipe entirely over the wall of the canal. The party was escorted by Mr. W. A. McFarland, Asst. U. S. Engineer, in charge of the maintenance of the canal, under Capt. G. W. Goethals, U. S. Engineer.

BOSTON SOCIETY OF CIVIL ENGINEERS.—At the meeting on May 23, Mr. F. P. Stearns described the proposed improvement of the Charles River. There are two ways of preventing the exposure of the flats. One is to build walls and dredge the flats after the plan carried out in Cambridge. The expense is an objection to this. Another method is to dam the river, in order to maintain the water through a certain length in its course at a permanent high level. The suggestion of the joint board was to construct a dam about 600 ft. above Craigie's bridge, which is to contain a lock of sufficient size for the largest vessels that are likely to ever go up the river, with openings for the discharge of the flow of upland water and maintain a basin above extending to the Waltham line, keeping the water therein at a constant level, about 2 ft. 6 ins. below ordinary high tide. The public ownership of the banks of the stream was also recommended. Mr. Stearns concluded his address by explaining some of the suggested methods of engineering in the construction of the dam, embankment walls, etc.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The thirteenth annual convention will be held at the United States Hotel, Boston, Mass., on June 14, 15 and 16. Papers are expected as follows: "Laying a 16-in. Main Across a Rocky Mill Stream and Over a Dam," by Geo. F. Chace. "The Water Service and Fire Protection of Theatres," by Wm. Paul Gerhard. "Experiments with Tube Wells at Lowell, Mass.," by Geo. Bowers. "Some Examples of Underground Water-Supply," by J. J. R. Croes. "Electrolysis of Water Pipe," by C. A. Stone. "The Lawrence Filter Bed and Its Results," by Hiram F. Mills. Discussion on the "Care of Water Meters," to be opened by J. C. Whitney. "What a Water Supply Engineer Can Do in the Fire Department," by Jas. E. Tryon. "Latest Improvements in Pumping Machinery," by E. D. Leavitt.

At 11 a. m., Friday, an excursion will set out to visit points of interest connected with the water systems of Boston, Newton and Brookline; Saturday forenoon will be devoted to a visit, by steamer, to points of interest in Boston Harbor, through the courtesy of the city of Boston. The display of waterworks appliances this year will be in charge of Mr. Harold L. Bond, of Perrin, Seamans & Co., 57 Oliver St., Boston. Further information may be obtained from Mr. R. C. P. Coggeshall, Secretary, New Bedford.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The regular informal monthly meeting was held May 16, with the President, Mr. Chas. S. Churchill, in the chair. The subject of "Photochromy, or the Reproduction of Colors by Photography," was presented by Mr. Rene de Saussure. After giving a brief account of the photographic art and of the partially successful attempt to bring out colors by the use of colored screens, he gave a description and demonstration of the scientific theories involved of the latest and very successful effort of a French scientist who is said to have reproduced the exact colors of the object on the plate, but which colors, however, cannot be transferred by printing. The only difference between this process and that ordinarily used is the finer preparation of the plates and the introduction of a mirror in the camera immediately behind the plate. The principles involved are the relative lengths of the waves of light for the different colors, and the interference produced by the reflected rays acting with the direct rays of light. The process is a demonstration of the correctness of the wave theory of light, as the whole process is worked out on that theory as a basis. The one drawback to the colored photographs coming into common use is that the plates have to be extra fine and sensitive and have to be used within a day or two after they have been prepared, and so cannot be put on the market for sale. It is more than likely that this difficulty will be overcome before very long, and who can tell but that even the process for printing the colors may be found. The summer meeting will be held July 14.

J. A. Pilcher, Secy.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
June 2. Secy., L. F. Rondinella, 1122 Girard St.

SWEDISH ENGINEERS' CLUB.
June 2. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 5, 8. Convention at Montreal, Can. Secy., F. R. Hutton, 12 W. 31st St., New York City.

WESTERN SOCIETY OF ENGINEERS.
June 6. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 6. Annual meeting at Niagara Falls, June 20. Secy., F. Collingwood, 127 E. 23d St., New York.

ENGINEERS' CLUB OF ST. LOUIS.
June 6. Secy., Wm. H. Bryan, Turner Bldg.

MONTANA SOCIETY OF CIVIL ENGINEERS.
June 9. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
June 11. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
June 11. Secy., M. F. Schinke, City Hall, Milwaukee.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 12. Secy., F. C. Osborn, Case Library Building.

NORTHWEST RAILWAY CLUB.
June 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
June 12. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.

DENVER SOCIETY OF CIVIL ENGINEERS.
June 12. Secy., F. E. King, Jacobson Block.

MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
June 13. Wichita, Kan.

NEW ENGLAND RAILROAD CLUB.
June 13. Secy., F. M. Curtis, P. O. Box 1576, Boston.

ENGINEERING ASSOCIATION OF THE SOUTH.
June 14. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 14. Secy., G. W. Shaw, Norton Building.

NEW ENGLAND WATER-WORKS ASSOCIATION.
June 14, 16. Annual convention at Boston. Secy., R. C. P. Coggeshall, New Bedford, Mass.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 15. Secy., D. W. Meeker, St. Paul.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
June 15. 201 Washington Building.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
June 17. Secy., C. H. McLeod, Montreal, P. Q.

ENGINEERS' CLUB OF MINNEAPOLIS.
June 18. Secy., E. Nexsen, 504 Kasota Block.

MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

COLUMBIAN ENGINEERING SOCIETY.
June 19. Secy., F. W. Hart, Washington, D. C.

BOSTON SOCIETY OF CIVIL ENGINEERS.
June 20. Secy., S. E. Tinkham, 36 Bromfield St.

ENGINEERS' CLUB OF CINCINNATI.
June 21. J. F. Wilson, 24 W. 4th St.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
June 21. Secy., Howard Berge, 100 Washington St.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 21. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 6. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 6. Secy., O. Von Geldern, 719 Market St., San Francisco.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
July 14. Alleghany Springs, Va. Secy., J. A. Pilcher, Roanoke, Va.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Entered at the Post Office, New York, as Second Class Matter.

VOL. XXXI. THURSDAY, MAY 31, 1894.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS.
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER,.....ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER.
F. P. BURT.....ASSISTANT MANAGER.

CHICAGO OFFICE: 1,636 The Monadnock.

CHAS. S. HILL.....RESIDENT EDITOR.
F. A. PECKHAM.....ADVERTISING MANAGER.

EUROPEAN AGENCIES:

KEGAN PAUL, TRENCH, TRUEBNER & Co. (Limited), Paternoster House, Charing Cross Road, London, Eng.

SAMPSON LOW, MARSTON & Co. (Limited), St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00; single copies, 15 cents. To all other countries in the Postal Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The date when the subscription expires is on the address label on each paper: the change of this to a subsequent date is the only receipt sent, unless by special request.

ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The pertinence of the common clause in advertisements for sealed proposals to the effect that the bids received will at a given time and place be "then and there publicly opened and read," is illustrated by a letter to this journal from a Southern correspondent. After giving a list of bids recently received and opened by the mayor of a certain Southern city for building a system of water works, he continues:

> After these bids were read the mayor remarked that he had left one bid in his private drawer at home, and he retired to get it. He returned with the bid of Blank & Blank, who had remained outside during the reading of the bids. Their bid knocked off an odd fifty or sixty dollars from the lowest of the bids which had been previously read, and in spite of protests they were awarded the work at this figure.

There are cases where circumstantial evidence is so convincing as to amount to positive proof. If the facts are correctly reported to us, we should say that this was a case which came under that head.

We have illustrated at various times during the past year or two, examples of the progress made in Germany and Austria in the use of combined iron and concrete in the construction of buildings, bridges, sewers, etc., according to the plans developed by Monier, Melan and Wuensch.*

Our attention has recently been called to the fact that the combination of iron and concrete in construction was developed in this country over a score of years ago, and was described at some length in a paper by Mr. W. E. Ward, President of Russell, Burdsall & Ward, of Port Chester, N. Y., read before the American Society of Mechanical Engineers at the Cleveland meeting of 1883 ("Transactions," Vol. IV.). Mr. Ward's use of combined iron and concrete, however, antedated the reading of this paper many years, he having built his own residence on this plan in the early part of the '70's.

Mr. Ward's method of construction for beams was quite similar to that developed by Melan. Our readers will also recall the method of concrete and iron construction involving the embedding of twisted iron rods in the concrete developed by Mr. Ernest L. Ransome, of San Francisco, and illustrated in Engineering News of Sept. 2, 1888, and Feb. 16, 1893. Mr. Phinehas Ball, of Worcester, Mass., was also, we believe, an early experimenter in this field.

It is fair to say, however, that whether or not American inventors were the first to reduce iron and concrete construction to practice, its extended commercial development first took place on the European continent. The high prices of iron and of cement have doubtless been a chief factor in preventing such construction from gaining a foothold here; but the lower scale of prices now prevailing, coupled with the demand for a better and safer and more permanent construction will have its influence doubtless in bringing such systems into more extended use.

* See Eng. News, May 23, 1891, Feb. 16, Aug. 24, and Nov. 16, 1893, and April 12, 1894.

We doubt whether even engineers fully realize the fact that the hope of cheapening the cost of transportation at the present day rests far more in the reduction of terminal charges than in a further reduction in the cost of hauling "on the road," be the transportation by rail or by water. By "terminal charges" we mean all the expense of handling from the time a shipment leaves the main track at the end of its journey to the final landing in the storehouse of the consignee.

We give considerable space in this issue to a paper discussing one important item of railway terminal charges, the switching of cars in making up trains, etc. The author presents a computation showing that the mileage of switching locomotives on five principal New England railways in 1892 was 41 per cent. of the mileage of locomotives hauling freight trains on the road. The total cost of switching work on these five roads he computes to be about $3,407,000 per annum, which is about 20 per cent of the total operating expenses of these roads which are chargeable to freight traffic. Who would have dreamed in the days when the six-horse wagon was the best available means of freight transportation that the last decade of the century would see freight moved at so low a cost that simply arranging the loaded vehicles in trains would constitute a fifth of the entire cost of moving it?

But while these figures well illustrate the phenomenally low cost at which goods are now moved, they also hint that there is room for improvement in methods of switching and making up trains. Anyone who watches the process of "drilling" cars as it is carried out in almost any large yard, must be impressed with the fact that a singularly large amount of work is required to accomplish a very small result. A ponderous switching engine slipping its drivers in the attempt to move a long string of cars, in order to cut out two or three, or perhaps a single car, from the center of the string, means a large consumption of time and power, of which the great bulk is absolutely wasted. With the rapid growth of traffic of the past decade, yards have been enlarged by placing additional tracks wherever room could be found. Larger yards have enabled larger strings of cars to be accommodated, and heavier engines have been necessary to handle them. It is the rule in a switching yard to stop at nothing which the locomotive has capacity to pull or push. The result has been that breakages of draw-gear have enormously increased, and must be expected to keep pace with the improvements in such gear so long as the increase in power of switching locomotives continues.

Bearing these facts in mind it appears that the design of yards for more conveniently sorting cars and making up trains is a field in which there is much opportunity for good work to be done, and one which those engaged in railway work will do well to cultivate.

Elsewhere in this issue we present some new specifications for structural steel drawn by Mr. Geo. H. Thomson, M. Am. Soc. C. E., the well-known bridge engineer, which for strictness and extent of "territory" covered, exceed any specifications which we now recall. It has been generally accepted by engineers in recent years that specifications for steel should set forth only the physical characteristics required, strength, ductility, etc., and the manufacturer should be left free to make metal of such chemical composition as he found necessary to fulfill the tests. Mr. Thomson's position, however, is that not only the physical characteristics of the metal and its chemical composition must be specified, but the whole process of manufacture, from the ore to the completed and assembled structure, must be watched by an inspector to ensure that it is correctly and honestly carried on. Mr. Thomson gives as a reason for these requirements his belief that all physical tests which have been devised, together with chemical analysis, will not ensure sound, safe and reliable metal. Consequently he insists that the whole process of manufacture must be supervised by an inspector.

It must be confessed that the position above set forth is one that is rather disheartening to engineers. Time and again it has been emphatically stated that if a manufacturer of steel actually desired to make second class material, all the inspectors which an engineer could put about the works could not prevent him. We have an excellent example of this fact in the recent exposure of fraudulent practices in the manufacture of armor plate at the Carnegie Works. Surely if the Government with all its resources in the matter of inspection and inspectors could not detect these petty deceits in the manufacture of armor plate for which it was paying $600 a ton, we may safely conclude that a private company's inspectors could not prevent similar practices by any dishonest manufacturer who is striving to reap a profit in making structural steel at $30 a ton. Further, to do all that is apparently contemplated by Mr. Thomson's inspection, the inspectors must be practical experts in steel manufacture, and a double force must be provided, so that they can be on duty night and day. The expense of providing for such an inspection would be enormous.

And now let us look at this matter from the standpoint of the purchaser of structural material. He must trust somebody; shall it be the manufacturer or the engineer? If he pins his faith to the latter according to Mr. Thomson's plan, he must not only foot the bills for an elaborate system of inspection, but must take the risk that the manufacturer will so resent the espionage upon his work that he will lose no opportunity to hoodwink and cheat the inspectors, and thus defeat a system which is naturally most distasteful to him.

There has long been a contention between manufacturers and engineers as to the value of physical tests and specifications. The manufacturers have urged consumers that the reputation of the steel maker was a better reliance than any specifications and tests which the engineers could devise. The engineers have urged that to place sole reliance on a steel maker's reputation resulted in paying fancy prices for steel, and that a properly drawn specification based on physical tests was a better assurance of good material while it placed the contract tract open for general competition. If Mr. Thomson's claim that the engineer cannot determine by tests made after manufacture whether steel is safe and reliable is once admitted, that for which the engineers have long been contending may as well be abandoned. We apprehend that engineers and steel users generally will be very slow to accept the doctrine that the best tests now in use are not sufficient to prove the character of structural steel and to detect that which is for any reason unsafe for use.

We alluded last week to the anxiety under which Philadelphians are laboring lest their asphalt streets be dissolved by the rains, this fear having been awakened by the announcement that the watering carts must keep off the asphalt streets lest injury be done to the paving. It is now stated that street sprinkling will go on during the coming summer, asphalt or no asphalt, and, as the deluge of rain which came down on the city a week ago left the asphalt still in evidence, the hope is expressed that it will be able to survive the gentle showers from the watering cart. A new difficulty, however, has now appeared. Two cases are reported in Philadelphia newspapers of loaded teams getting "mired" in the asphalt. In the first, a two-horse truck loaded with flour stopped about five minutes on Girard Ave., below Hancock St., and, according to the veracious reporter, the wheels had sunk into the asphalt fully 3 ins. by the time the driver at-

tempted to start his team, and the truck had to be unloaded before it could proceed. The second case is reported as follows by the Philadelphia "Inquirer" of May 19:

A truck drawn by four horses, and loaded with eight tons of rails for use on Spring Garden St., became stalled on Twelfth St., above Melon St., yesterday afternoon. About 1 p. m. the colored driver guided the heavily-loaded truck off the tracks to make way for a trolley car which was approaching. The truck had just fairly cleared the track when each of the four wheels sank about an inch and a quarter into the asphalt, which had become softened by the hot sun.

A trolley car was attached to the front of the wagon by a chain, and while the electrical power was applied the horses were whipped up, but together they could not budge the truck, which had to be unloaded. The tires had been about 3½ ins. wide, but they were worn on the side so that the surface was rounded instead of being flat.

If these things happen in May, what will occur in July? Apparently Philadelphians will have to shade their asphalt with umbrellas if they expect to keep in motion over it this summer. It is curious that with nearly a thousand miles of asphalt paving in use in this country instances of vehicles being stuck in it have never before been reported, so far as we are aware. Some ill-natured person might suggest that the prevalent rate of motion in the Quaker City had something to do with the remarkable occurrences above reported; but it would sound so much like a libel to say that a city was so slow that the vehicles in the streets would stick fast on an asphalt pavement that we prefer to believe that the paving contractor must have laid a highly unique variety of asphalt on Philadelphia streets.

The newspapers are making considerable clamor over the results of the recent test of the Bethlehem 18-in. armor plate, and some erroneous impressions concerning the real results of that test are likely to be formed, even by engineers. The simple fact is that whether a plate will be cracked or penetrated by a projectile merely depends on how the balance stands between the foot-tons of energy in the projectile and the potential foot-tons of resistance in the plate. Most of the armor plate tests which have been made in this country have been made with 6-in. and 8-in. guns, throwing projectiles with some 1,500 to 5,000 ft.-tons striking energy. The 12-in. rifle throws projectiles which strike with an energy of nearly 25,000 ft.-tons, thus the difference between the two may be roughly compared to the difference between a blow from a pugnacious school-boy and one from Corbett's powerful fist.

A little less than a year ago (Eng. News, July 13, 1893) a 17-in. Bethlehem nickel-steel plate received three shots from the 12-in. gun. The first shot lacked half an inch of going through; the second went 3 ins. into the backing, and the third went through plate, backing and all, without, however, cracking the plate. In these later tests at Indian Head a plate 1 in. thicker and Harveyized has again been fired at by the 12-in. gun. Every one knows that the Harvey process makes the plate more liable to crack than if it were not so treated; and an elementary knowledge of mechanics teaches that a 12-in. wedge is much more likely to cause a crack than a 6-in. or 8-in. wedge. That the plate was badly cracked by the shots, therefore, may show that the plate was defective or merely that it was overmatched by the blow of the projectile fired against it. Another plate is soon to be tested and after that test a better opinion can be given as to the cause of the cracking.

Apropos of this recent test, and as an example of the "blind guides" which the newspapers are when technical matters are involved, we notice a long account of the recent test in the Jacksonville (Fla.) "Times-Union." As stated above, the plate was made at the Bethlehem Iron Works, but the newspapers have been so filled with the charges and counter-charges concerning the Carnegie armor plate manufacture, that the intelligent editor evidently concluded that these tests must have something to do with that investigation, so the following was set up in staring headlines as the caption to the press despatch:

"Rotten, Utterly Rotten.
That Describes the Carnegie Armor Plates.
Split Wide Open by a Shot.
Cost Very Heavy to Carnegie.
The Scotchman, who has been Fattening on Protection and Contracts, Must Pay $20,000."

ENGINEERS AND ARCHITECTS.

The subject of engineer vs. architect, which excited considerable discussion a year or so ago, comes to the surface again this week in a letter from a correspondent, published in another column, in which the inquiry is made, "Why is not the engineering work in a city like New York done by engineers?" The especial reference is to a piece of badly designed steel construction for an important building, for which, it is stated, the architect was responsible.

It is a common trait of human nature to estimate one's own efforts and work at their full value; but the engineer who is responsible for the design of foundation and framework of a modern high building is hardly to be blamed for feeling that his work, on whose accuracy and faithfulness the safety of the structure and its inmates depends, is of the first importance. Many of our readers will recall the general feeling of protest among engineers when at a public banquet a year or more ago a noted architect took occasion to say that the architects were the people who had made the Columbian Exposition; and as for giving credit to the engineers for their part of the work, they could be picked up on the street whenever they were wanted. Probably the sentiment then expressed is not that generally held by architects or by the public; but whether it is or not, we have to take the age we live in as we find it, and have to recognize the fact that the man who is about to build goes to the architect, and not to the engineer, and leaves to the architect the responsibility of safe construction. Under these circumstances, the engineer engaged in this especial line of work must of necessity rely on the architect for employment; and if the architect chooses to design the framework of his building by rule-of-thumb rather than employ a competent engineer, the engineer who is deprived of the opportunity for employment has no recourse. We can only hope for gradual improvement through better building laws and better inspection by building departments, and through the education of architects and of their clients to the importance of good engineering both from the standpoint of safety and as a matter of dollars and cents.

Closely connected with this subject is the matter of relative compensation. We have no reason to believe that engineers are more numerous in proportion to the demand for their services than are architects; but the architect's charge to a client is not necessarily scaled down because a half-dozen other firms would have been glad to do the work; while the engineer's weekly salary can be held down to a microscopic size simply by virtue of the bunch of applications for a job, from other engineers, which are on file in his employer's desk. It is not at all strange that under these circumstances the engineer should hanker to exchange places with the architect, and become the employer instead of the employee. One can imagine the man about to build seeking the engineer with instructions to design a building safe against all destructive forces, equipped with the most efficient machinery for heating, cooling, lighting, ventilating, draining, etc., and built in the best possible manner to suit its intended uses. One can also see in dim perspective the engineer employing the architect (at draftsman's wages) to sketch the ornamental features of the design. One can imagine such a revolution occurring—if his imagination be powerful enough—but we hasten to say that we see no present indications of its appearance and are by no means sure that it is a change to be desired.

One strong reason for the movement toward making a sort of guild or series of guilds of the engineering profession, of which a good deal was heard a year or more ago, was doubtless the practice of the American Institute of Architects in regulating the commissions charged by its members. There is probably much to be said in favor of the establishment of a standard schedule of fees for engineering work; but the fact must be recognized that it would be a far more difficult task than was the case in the architectural profession, and it would be better not to attempt such a thing at all than to have such a schedule established and then ignored by members of the profession. The fact is, if we are correctly informed, that the architects themselves are not so successful in sticking to their established schedule as is sometimes imagined. This is true not only of the "outsiders" but of many members of the Institute as well.

Even if the architect is successful in securing his five per cent. commission, however, we are not at all sure that the engineer does well to envy him. The engineer may feel that times are hard when he is invited to put in a competitive bid for doing some small piece of purely professional work, or when some new instance occurs of the submission of competitive plans for a system of water-works or a bridge; but he may reflect that competitions are not the exception but the rule for important public works in the architectural profession. Surely the man who, after spending hundreds of dollars in making drawings and elaborating his design, finds that he is only one of a hundred and odd competitors, deserves five per cent. commission—if he is lucky enough to get it.

In connection with the idea which may possibly be held by a few engineers that the architect may eventually be employed to play second fiddle to the engineer, it is well to state that the artistic features of a building, if it have any to speak of, must be determined before the engineering problems to be solved are even known, so that in the imaginary case cited above the so-called engineer would be the real architect, so far as there was one, and the so-called architect would be only a good draftsman, skilled in working up special details outlined by his employer. In other words, architecture is an art, and the man who designs a building of real architectural merit is an artist and secures his artistic effects through form, proportion, light, shade, color, treatment of blank and open spaces and the general outlines of his structure, always keeping in mind the uses to which his building is to be put. Now, upon the combination of these various elements of design depend many, and often most, of the strictly engineering features involved; and until the most essential of these artistic elements are determined the engineering problems are not ready for solution, although they must be kept constantly in mind during the evolution of the general artistic features of the building. If an engineer can design a building along these lines he is entitled to rank in both the architectural and engineering professions and needs no more assistance from architects than any other architect who employs a large force of draftsmen to develop his ideas.

There is no real conflict between the two professions and it is a mistake to make or encourage one. Each profession overlaps and supplements the other. The best men in each can employ at daily or monthly wages an almost unlimited number of men from the other, often very good men, too. Such envy or jealousy as exists is quite likely to be caused by comparing men of low rank in one profession with those of high rank in the other, or by thoughtless or ill-natured remarks made in public and passed from one to another, like that mentioned above in connection with the Exposition.

In conclusion, it should be said that the young engineer is generally better paid than the young architect and has before him a much wider range of possible employment, both in and out of his profession, than has the young architect, for the latter is virtually restricted to architecture, or possibly some of the building trades, unless he gives up all connection with his profession, while the engineer can enter many fields of industry with services rendered more valuable because of his engineering knowledge and experience.

LETTERS TO THE EDITOR.

THE NEED OF INSPECTION FOR STRUCTURAL MATERIAL.

Sir: The article headed "Failure of a High Building by Wind Pressure, New York city," in Engineering News of May 24, shows clearly the value of an intelligent inspection of this class of structural metal work during its manufacture at the mills and shops. With inspection of the proper character, such defective workmanship as described in that article would have been discovered in the shop and there corrected. As a matter of fact, not one such building in ten is inspected by a representative of the architect or owner at the rolling mills and structural shops. In many cases full specifications covering quality of material and workmanship are prepared and then the whole thing is left without any provision for seeing whether the specifications are fulfilled or not.

The recent articles on "Stand-pipe failures" in Engineering News also point to a general carelessness in purchasing this class of material without knowing whether it is suitable for the purpose or not. Of course the iron and steel work for many large buildings is thoroughly inspected, notably when erected in Western cities, and the same is true of the material for many stand-pipes; but the fact remains that fully 90% of this class of material and the workmanship put upon it is taken from the makers absolutely on faith.

Yours truly, C. B. Colby.

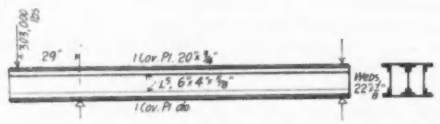
Philadelphia, May 25, 1894.

DEFECTIVE IRONWORK IN BUILDINGS AND THE RESPONSIBILITY FOR IT.

Sir: In a city like New York it would seem that all work in connection with buildings, however unimportant, would be subject to careful consideration before being executed. But it appears to be the case that such consideration is not given, even to important structures. Recently it devolved upon the writer to proportion the rivet spacing for a number of girders which had been designed by an architect for a building now under construction in this city. In attempting to do this, it was discovered that the girders had been proportioned by mere guesswork; that it was impossible to develop the full value of the flanges, owing to a lack of rivets; and that the stiffeners for bearing over the supports were inadequate for the duty that they would be called upon to perform.

All this kind of criticism must sound very familiar to engineers who have had occasion to examine similar work. However, the strange part of it all was that the design could not be altered in any way, because the Building Department had approved it!

To illustrate the faulty design of this work, the writer gives the data used in designing one of these girders, and the results obtained. A load of 303,000 lbs. is carried by a projecting girder as a cantilever. The projection measures 29 ins. between center lines, thus:



Top and bottom flanges, each, four 6 × 4 × ⅝-in. angles, one 20 × ¾-in. plate; web plates, three 22 × ⅞-in. plates, all steel. The rivets were to be proportioned for shear at 9,000 lbs., and the permissible bearing was assumed at 18,000 lbs. per sq. in., or twice the shear. At a glance, it is evident that one-half of the metal in the outer webs is useless, as the outer webs can each do only one-half of the duty that the inner web can do. It might be argued that the webs were proportioned to resist the shear due to the vertical load. Be that as it may, such a thing as shear on the vertical section of a web in a girder does not exist as long as the web invariably fails through other causes. Assuming 1-in. diameter rivets, and that the moment of inertia of the entire cross-section of the girder is effective in resisting bending, an assumption most favorable to the rivets in the flanges, the minimum spacing was found to be less than 2 ins. In another case, for ⅞-in. diameter rivets, the minimum spacing was 1⅝ ins. It should be explained that the flange angles had the 6-in. legs vertical, permitting two rows of rivets in the 6-in. leg. The spacing which was used was 2 ins. for ⅞-in. diameter rivets, and 2¼ ins. for 1-in. diameter rivets, all staggered in two lines, 2 ins. apart. All the material is steel, and was punched and not reamed. The effect of punching ⅞-in. steel web plates for 1-in. rivets about 3 ins. apart can well be imagined.

All this leads to one question: Why is not the engineering work in a city like New York done by engineers? Yours truly,

J. W. Schaub, M. Am. Soc. C. E.

New York, May 2, 1894.

(To answer our correspondent's question, the lack of proper engineering in such cases as he instances is due usually to the attempt of an architect to do work in designing structural details for which he is not competent, or sometimes to the intrusting of the work by the architect to some inexperienced man, whose services are secured because they are cheap. The best architects employ or are associated with competent engineers, and this must come to be more and more the universal rule with the increasing use of steel construction and as the manifold problems involved in the heating, lighting, ventilation and drainage of buildings, increase in importance and complexity.—Ed.)

ADJUSTING COMPASS ZEROS.

Sir: Relative to adjusting compass zeros on transits, Mr. L. E. Gurley in discussing the magnetic needle before a convention of surveyors, said in my presence that he made six needles as nearly alike as he could make them, and tested them thoroughly on the same pivot. Three of them gave the same results and the other three varied from 5′ to 10′. I wonder if it had occurred to your correspondents on this subject that the needles themselves do not point in the same direction when tested at the same time and place.

Climax, Mich., May 21, 1894. F. Hodgman

THE BROOKLYN BRIDGE TERMINALS.

Sir: In thinking over the Brooklyn Bridge terminal problem, the arrangement of tracks and platforms shown in the accompanying sketch has suggested itself.

It may be old, but I have not seen it anywhere. The first train would run in on track A, load and unload at the same time, the second would run in on track B, load and unload there. But one stop would be required and no crossing of tracks. Yours truly,

New York, May 24, 1894. C. D. Ward.

(The great disadvantage of this plan is obviously the length of station required for two platforms for four or five car trains, with switching room between the ends of the platforms. A somewhat similar plan, but with separate grades allowing of a double-story station has already been suggested more than once.—Ed.)

THE HYDE PARK OR 68TH ST. TUNNEL EXTENSION, CHICAGO WATER-WORKS.

By John Ericson, Assistant City Engineer.

(With inset.)

A description of the water-works tunnel and submerged crib, built in 1884, by what was then the village of Hyde Park, but has since become a part of Chicago, appeared in the Engineering News of Jan. 12, 1889. The article proved of considerable value to the engineers that were later charged with the construction of the extension of said tunnel. I am, therefore, confident that an article on the recently finished extension will be not only of interest

Fig. 4. Alinement, Profile and Triangulation System, Hyde Park Water-Works Tunnel, Chicago Water-Works.

to engineers and contractors in general, but of great use to those who may be charged with a future extension of the tunnel.

The old 6-ft. tunnel, terminating with a submerged intake 5,046 ft. from the land shaft, close by the lake shore, having lately proved to furnish a water supply the quality of which was not the very best, it was decided early in 1892 to construct a 7-ft. extension of the tunnel terminating with the crib about two miles from shore. Bids were invited, which resulted in the awarding of the contract to the firm of Lydon & Drews, of Chicago, April 20, 1892, said firm being the lowest bidders.

As the World's Columbian Exposition was to be supplied with water drawn through this Hyde Park tunnel, it was very desirable to have the new extension finished in time for the opening of the Exposition. It was therefore decided to construct and place an intermediate crib 6,500 ft. from shore, in order to allow the prosecution of the work from three headings. A plan and profile of the old tunnel and the extension is shown by the accompanying cut (Fig. 4) in the text and further illustrations of the extension are presented on the inset sheet.

Difficulties presented themselves at the very beginning and continued throughout the work, making progress at times exceedingly slow and dangerous, requiring great care, and calling into play all the experience and skill of the engineers and the contractors.

The original design was to build the tunnel westward to about opposite the submerged intake, and to connect the new with the old tunnel at that place. In order to do this the water would have to be pumped out of the old tunnel. To supply water to the pumps during that time, a shore tunnel, 5 ft. in diameter, was built, terminating with a crib (A) about 900 ft. from the shore. Subsequent extensions of a pier and the filling in of the lake at that point caused the water to be taken from this shore intake so liable to shore pollution that the scheme was abandoned, and it was decided to continue the 5-ft. shore tunnel out lakeward to meet another 5-ft. tunnel branching out from the new 7-ft. tunnel, some 1,200 ft. west of the submerged intake. This would do away with any shore intake entirely and it was contemplated to either place a bulkhead in the 7-ft. drift near the proposed connection with the old tunnel and just west of the bulkhead a temporary working shaft from which the connection could be made and the bulkhead afterwards removed by a diver, or to continue the 7-ft. tunnel to shore, reducing the same to a 6-ft. tunnel.

It has not at the time of writing been finally decided which of these two methods will be adopted. In case the last mentioned is adopted, the old tunnel and intake will be used as an emergency intake.

It was at one time proposed to continue the new 5-ft. tunnel to a pumping station in the southern part of the city, in which event the 7-ft. extension would furnish water through the old 6-ft. tunnel to the 68th St. or Hyde Park pumping station, and also to the 5-ft. tunnel, as just stated.

The two cribs east of the submerged crib were built of 12 × 12-in. timbers, 10 miles from their present location, towed out, sunk, and filled with riprap. Their design is shown by Figs. 1 and 2. The inner crib was sunk in position Aug. 11, and the outer one Sept. 27, 1892. As soon as the cribs were provided with quarters for the men, the work of sinking the shafts immediately commenced. The upper part of the shafts consists of cast iron cylinders 10 ft. in diameter, in sections of 8 ft. length.

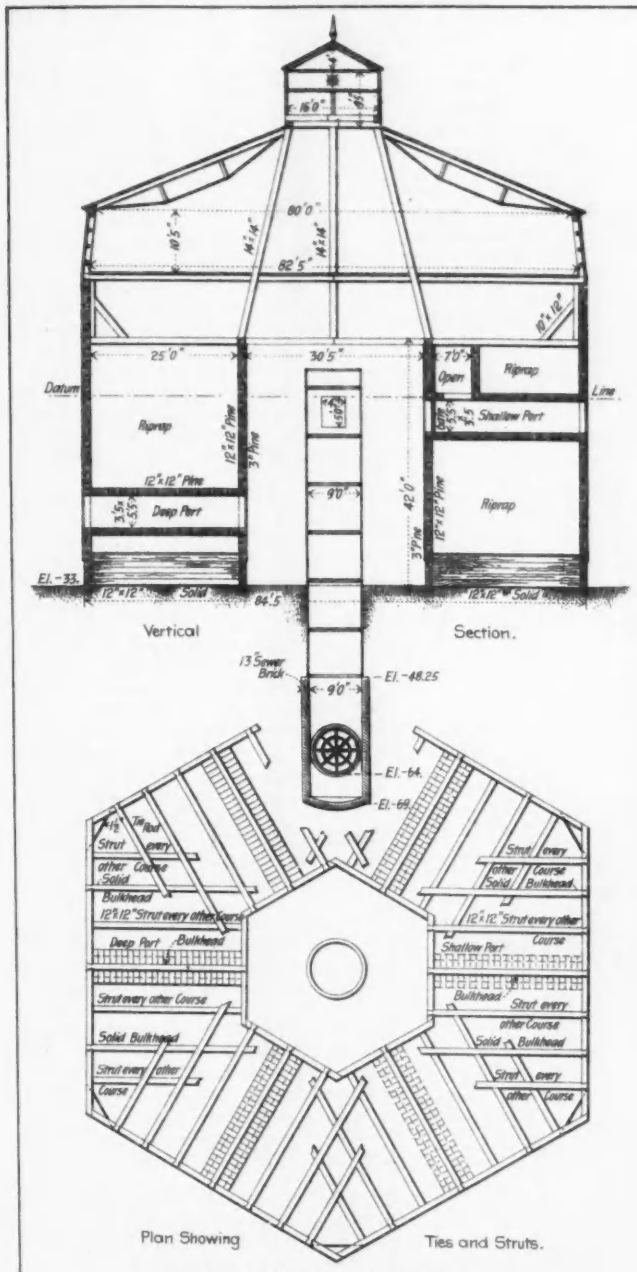


Fig. 2. Temporary Intake Crib.

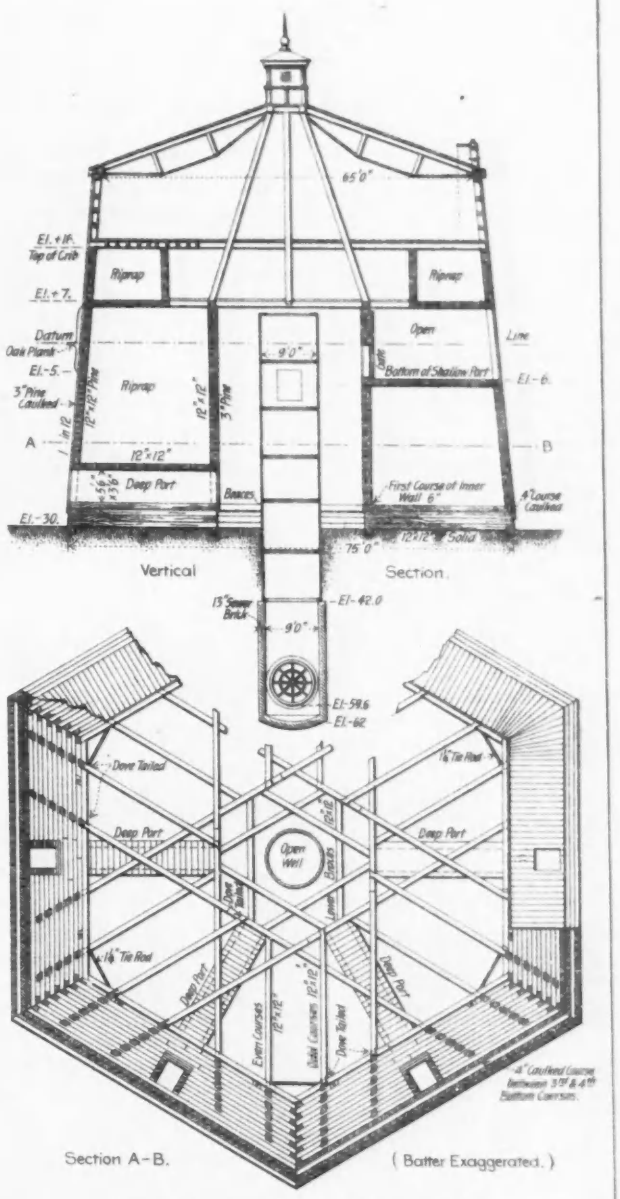


Fig. 1. Temporary Crib, 6,500 ft. from Shore.

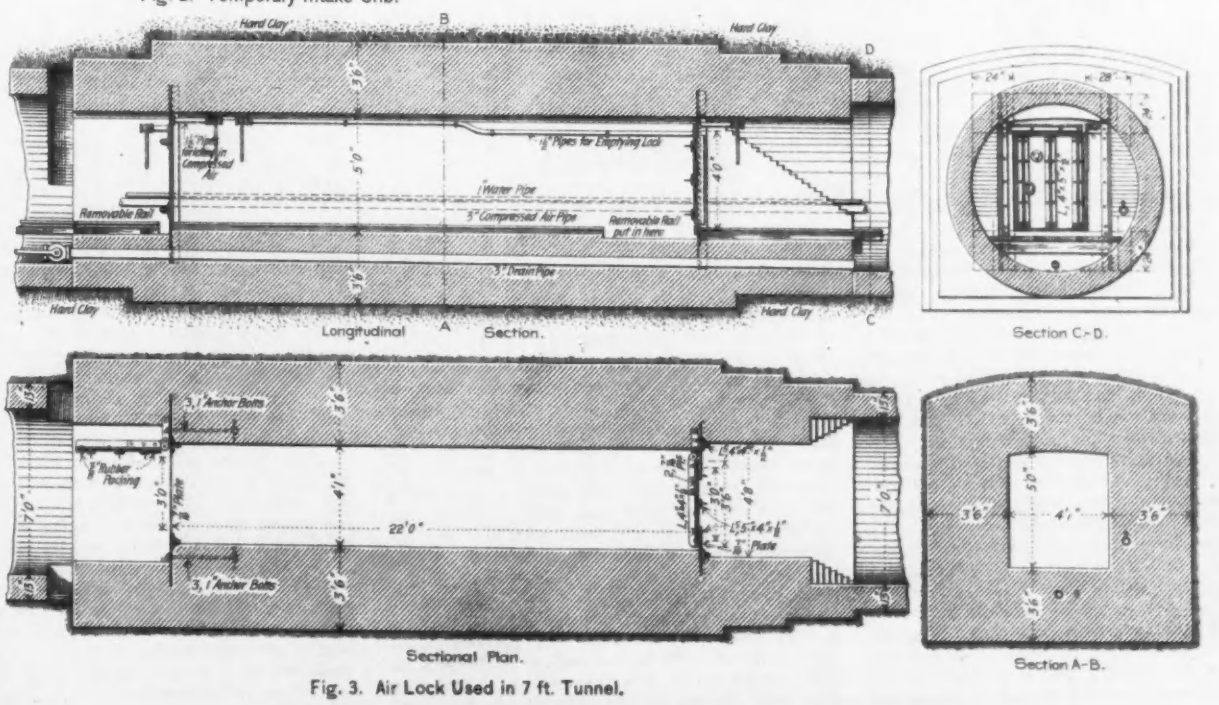


Fig. 3. Air Lock Used in 7 ft. Tunnel.

Hyde Park or 68th St. Tunnel, Chicago Water-Works.

Samuel G. Artingstall, City Engineer; John Ericson, Engineer in Charge; Lydon & Drews, Contractors.

CHAS. HART & SONS, LITH., 50 VESEY ST., N. Y.

The sinking of the inner shaft commenced Nov. 19, 1892. After penetrating hard blue clay to a depth of 9 ft. below the bottom of the lake a sand and gravel stratum made the sinking very difficult, owing to water forcing its way through the stratum up into the shaft. After reaching a depth of about 19 ft. below the bottom of the lake the water came in faster than it could be pumped out, and rapidly filled the shaft to the lake level.

The shaft was then weighted with some 250 tons of pig iron and excavation by jetting carried on inside by a diver. In this manner the contractor succeeded, after much worry and laborious work, in forcing the shaft down into the hardpan stratum underlying the gravel, far enough to seal the shaft. At the other crib no difficulty was met with in sinking the shaft. The soil at the place was very hard, but sealed the shaft thoroughly. Work now for a while progressed satisfactorily and without interruption.

In sinking the shaft at the inner crib, rock was found at an elevation of about —63, or 33 ft. below the bottom of the lake at that point. The specifications stipulated that "at no place except where necessary for connection of the new with the old work shall the top of the clear tunnel section be less than 25 ft. below the bottom of the lake at that point." According to observations made in sinking the shaft and in making borings in the vicinity of the crib, a sand stratum containing gas and water under pressure overlies the rock. In establishing the grade at this point, therefore, three propositions presented themselves to the engineers:

(1) To sink the shaft down into the rock and construct the tunnel entirely in rock at a great expense and with prospect of very slow progress.

(2) To establish the grade of the tunnel sufficiently above the rock and the water bearing stratum, taking the risk that a diminished soil roof might cause.

(3) To build the tunnel at the specified grade, which would necessitate the building of a part of the tunnel in rock and part in the strata overlying the rock. This, under the circumstances, would be a costly and troublesome work.

Owing to the great cost of constructing the Lake View Tunnel, the contractors for that work had just been ordered to raise the grade so as to avoid the costly rock excavation; also expecting at this time to finish the Hyde Park Tunnel in time to supply the Columbian Exposition with water drawn from the two-mile point, it was decided to adopt proposition (2).

The grade of the invert of the tunnel at the inner crib was then established at —59.6 ft., leaving a roof over the clear tunnel of about 21 ft. of soil. The shaft at the outer crib was sunk to an elevation of —64 and the roof over the clear tunnel at this point is 23 ft. thick. The lowest point in the bottom of the lake on the line of the tunnel is about halfway between the two cribs, thus making the roof less as the work progresses towards the point of meeting; at some places the soil roof over the tunnel is only 14 ft. thick.

After work had progressed about 800 ft. from either shaft water broke into both the drifts in such quantities as to entirely fill the outer portion of the tunnel and shaft and so as to necessitate the closing of the drift running east from the inner crib (drift No. 2) by a bulkhead in order to prevent the stopping of work on the entire new tunnel. An air-lock was then placed in drift No. 2, referred to, and the tunnel was thereafter constructed by the pneumatic process. The average progress made under the normal conditions was about 21 lin. ft. per day, while the average progress after compressed air was introduced was about 15 lin. ft. per day.

Difficulties on account of water were also met with in constructing the 5-ft. branch tunnel when about opposite the old submerged intake and an air-lock was also placed in that tunnel about 50 ft. from the connection with the 7-ft. tunnel. All that part of the 5-ft. tunnel between the submerged intake and the portion of the tunnel built from shore was constructed by the pneumatic process.

In order to redeem that portion of the tunnel constructed westward from the outer crib, and which had, as before mentioned, filled with water, an iron air-lock, shown by Fig. 5, in the text, was placed on top of the shaft; the gate-openings on the shaft which, on account of the impossibility of forcing the shaft down to the desired depth, were partly above the water surface, and closed with wooden plugs made of 12 × 12-in. timbers, well calked with oakum and red lead. Sept. 25, 1893, everything was in readiness to start the air compressor and in two days the tunnel was practically emptied of water. Laborers commenced immediately to clean out the drift and relay the floor and tracks.

On Sept. 28, one of the wooden plugs placed in the gate openings to prevent the escape of the air caught fire in some mysterious way. As no light was said to be kept near the plugs it was thought that the friction of the escaping air between timbers in the plug set fire to the oakum. However that may be the fact remains that a hole was burnt in the plug through which the air escaped. The tunnel and shaft refilled with water in five hours. The plug was then repaired and cement

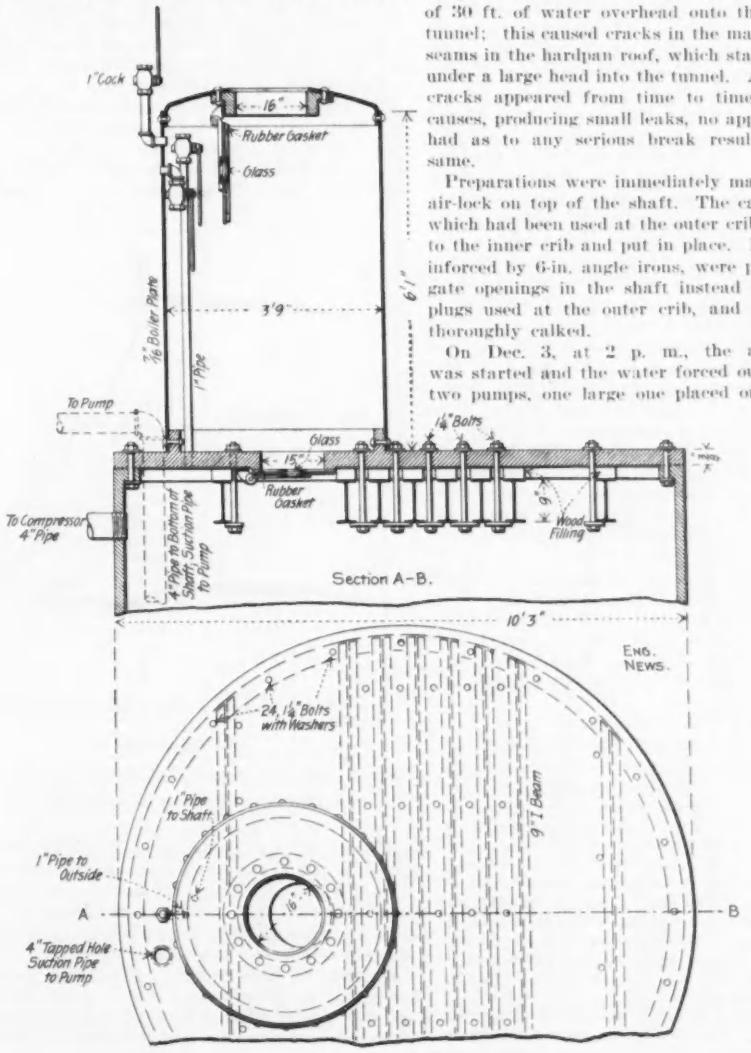


FIG. 5. AIR LOCK USED AT TOP OF SHAFT, HYDE PARK WATER-WORKS TUNNEL.

grouting forced in between the gates and the plugs, entirely filling the spaces. The air compressor was again started and the water pumped out of the shaft. As soon as the air found its way along the top of the tunnel and reached the face it forced a hole through to the bottom of the lake and escaped, throwing the water some 6 ft. above the lake surface.

The compressor was immediately stopped and the water quickly filled the tunnel and shaft. The hole in the bottom of the lake was examined and found to be about 3 ft. in diameter. Several thousand cubic yards of clay was then dumped over the hole. It was then decided to do all the tunneling from the inner crib, and leave the clay to thoroughly settle.

Meanwhile, work on the 7 and 5-ft. tunnels, prosecuted from the inner crib, progressed without any serious interruptions until Nov. 14, 1893, when a break occurred in that part of the 7-ft. tunnel running west from the inner crib, at some point west of the intersection with the 5-ft. tunnel. Men were working at the time in the 5-ft. drift, 1,575 ft. from the shaft, and in the 7-ft. tunnel east of the crib, 2,312 ft. from the shaft. The men were immediately called out. Some masons, in charge of their foreman, John Agnew, waded knee deep in water up towards the leak and attempted to build a bulkhead of cement bags, but were forced to leave the work uncompleted in order to save their lives. When they reached the shaft, the water was over the springing line, and was rising rapidly and soon filled the whole tunnel and shaft. When the pressure of the water forced the doors of the air locks open, the air escaped with a terrific noise.

At the point where the leak occurred a constant running of silt into the tunnel left voids behind the masonry, which had the tendency of bringing the weight of the roof with the addition of the weight of 30 ft. of water overhead onto the arch of the tunnel; this caused cracks in the masonry and also seams in the hardpan roof, which started the water under a large head into the tunnel. Although small cracks appeared from time to time due to these causes, producing small leaks, no apprehension was had as to any serious break resulting from the same.

Preparations were immediately made to place an air-lock on top of the shaft. The cap and air-lock which had been used at the outer crib were brought to the inner crib and put in place. Iron plates, reinforced by 6-in. angle irons, were placed over the gate openings in the shaft instead of the wooden plugs used at the outer crib, and the shaft was thoroughly calked.

On Dec. 3, at 2 p. m., the air compressor was started and the water forced out by means of two pumps, one large one placed on the crib and one smaller pump which was lowered in the shaft. In 50 hours the tunnel was practically free from water. An examination showed that the floor was in a very bad condition and the first thing done was to replace the floor and tracks. A 4-ft. bulkhead was then built in the tunnel, shutting off the portion where the break occurred. The 5-ft. drift was then bricked up and bulkheaded.

In drift No. 2, it was found impossible to brick up to the last length, as, notwithstanding the air pressure, the ground kept caving in on the sides as fast as it could be taken out, leaving the roof, which was about 30 ft. wide and rapidly growing wider, in an extremely dangerous condition.

This cavity was filled with timber and brick and a 4-ft. bulkhead built at the end of the brickwork. While the tunnel was under air pressure leaks showed in three places by air bubbling up through the lake. As a matter of precaution the air pressure was then taken off and the tunnel filled with water. Clay was then dumped on the bottom of the lake over these leaks and allowed to settle.

Jan. 6, 1894, the water was again pumped out and work resumed. Work now progressed without interruption, and as connection would soon have to be made between drift No. 2 and that part of the tunnel built from the outer crib. The next step was to get the water out of and secure the latter. The air-lock and cap was again placed on the shaft, loaded with pig iron, and connections made with the air compressor. On March 5 the compressor and pumps were started and in 30 hours the tunnel was dry. Solid bulkheads were then built at the end of the spur and the tunnel secured. The construction then proceeded without interruption and connection was made, the meeting being almost exactly as calculated. The air-lock used in the 7-ft. tunnel is shown by Fig. 3 on the inset.

Few lake tunnels, if any, that offered so many and serious difficulties in construction have been brought to so successful a completion. The most gratifying point is that no lives have been lost. It must be said in justice to the contractors, Messrs. Lydon & Drews, who are both experienced tunnel men, that they have left nothing undone that could be done to prosecute the work and protect the lives of the men. The work has been prosecuted under three different city engineers, as noted below, which accounts for the several changes in the plans. great credit is due the present city engineer, Mr. Samuel G. Artingstall, for the successful completion of the work. His valuable suggestions have done much towards overcoming difficulties met with.

The writer was engineer in local charge from the commencement of the work, with Mr. R. B. Wilcox as assistant, till June 1, 1893, when, at my promotion to the position of Assistant City Engineer, Mr. Wilcox was placed in local charge, with Mr. T. C. Anderson as assistant. The work is under my immediate supervision. The tunnel is now (May 21) completed, the telephone cable placed and water will be turned in before the end of this month. I am now preparing plans for a permanent structure of stone and concrete at the outer crib. The inner crib will be removed.

Mr. L. H. Clarke was city engineer at the time of letting the contract in 1892 and until Jan. 1, 1893, from which date until May 1, 1893, Mr. Dion Geraldine was city engineer and Mr. Bernhard Feind was consulting engineer. Since May 1, 1893 Mr. Artingstall has been city engineer, as mentioned just above.

A CONCRETE SEWER ON PILES. *

The work described in this paper consisted in the building by the Dock Department, at the foot of Canal St., North River, New York, of about 180 ft. of concrete sewer, 16 ft. wide by 7 ft. deep, on a foundation of piles and grillage, with overflow chambers designed to carry the storm water and sewage during very high tide. The area drained is 366 acres. The location of the work forbade the use of anything but floating derricks and other machinery in its construction, and all concrete, etc., had to be made on deck scows and wheeled to place. As the space for accommodation of the various scows, etc., was contracted, this added to the expense of the work.

Cast iron shoes for the piles were tried in driving through the cribs, but were not successful and were abandoned. The cost per pile for labor was $3.91. Two men, at good low tide, could saw off three of these piles during one tide at a cost of $1.28 each. Those sawed off at a greater depth were done by means of a large circular saw, suspended in the ways of a pile-driver. The grillage was built in sections and launched and floated in place at high water. Much delay in this part of the work was caused by the difficulty of getting stone, due to ice in the river.

Ten of the special concrete blocks had weights averaging 63 tons; five others weighed 40 tons each; all were set in place by a 100-ton floating derrick. Mattresses made of slow-setting Portland cement in the proportion of 2½ to 3 of sharp sand to 1 of cement, placed in bagging sheets and lowered into place by divers, were used on top of the low-grade piles, after which the blocks were set upon them. This was done to take up any irregularity in level of the tops of the piles.

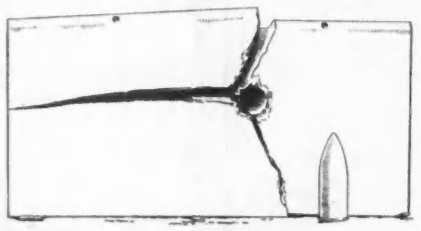
There were 71 sewer-wall blocks, weighing from 4 to 9½ tons each. These were set by smaller floating derricks, but great delay was occasioned by deposits from the sewer during flood tides, which frequently amounted to 4 ins. in depth. The sewer walls were made continuous by tongued and grooved joints. The cost of landing, handling and locating the 71 sewer-wall blocks was $19.39 each. This was done by dock builders. The cost of the concrete per cu. yd. in the ten special foundation blocks was $11.90; in the sewer-wall blocks, $11.20.

The iron I-beams that were used were "telegraphed" in place by a floating derrick. This "telegraph" consists of a double-drum hoisting engine, a mast or pile-driver ways, some lines and a snatch block. A heavy line is fastened to some distant point about on a level with the depth of the pile-driver, and is run over a sheave at the top of the pile-driver or derrick mast and led to the engine drum. A snatch block is then hung on this line between the points of support, to which the load is fastened with a smaller line leading over another sheave next to the first one, then to the second drum of the engine, and the telegraph is ready for use.

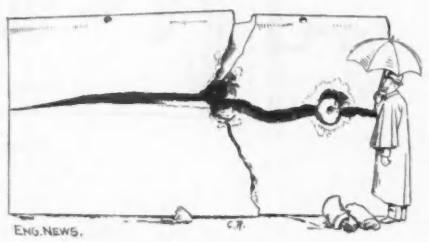
* Abstract (from Society's bulletin) of a paper to be read before the American Society of Civil Engineers, on June 6.

THE TESTS OF 18-IN. ARMOR PLATE.

On May 19 the first of the 18-in. armor plates for the side armor of the battle-ship "Indiana" was tested at the Indian Head proving grounds, two 12-in. armor-piercing shells being fired at it with the results shown in the accompanying sketches. The plate was a Harveyized nickel steel plate made by the Bethlehem Iron Works and is one of a lot of 613 tons intended for the side armor of the "Indiana." It weighed 33,500 lbs. and was 16 ft. long and 7½ ft. high. The upper 4 ft. of the plate was uniformly 18 ins. in thickness, the lower 3½ ft., which is below the water line, tapered to a thickness of 8 ins. The projectile used was a Carpenter armor-piercing shell, weighing 850 lbs., and fired with a charge of 269¼ lbs. of Dupont powder, giving it a velocity of 1,465 ft. per second, or a striking energy of some 14,252 ft.-tons. The projectile penetrated the plate and its point reached the backing and it then rebounded, upset, but little injured. The plate, however, was badly cracked, as shown in the sketch.



After First Shot.



After Second Shot.

18-In Nickel Steel Harveyised Armor Plate Tested at Indian Head Proving Grounds, May 19.

The second shot was fired with a charge of 419 lbs. of powder and the projectile had a muzzle velocity of 1,926 ft. per second, and a striking energy of some 24,255 ft.-tons. It completed the destruction of the plate, as shown in our second illustration. The projectile penetrated about 8 ins. into the backing and rebounded, badly broken up. We have commented on the results of the test in our editorial columns.

NOTES ON TRACK IMPROVEMENT.

In a lecture on track, delivered last March before the students of the University of Wisconsin, by Mr. L. F. Loree, Superintendent of the Cleveland & Pittsburg Division of the Pennsylvania Co., the growth and development of railway track to the present day were discussed and notes were presented as to future improvements in the track. Beginning with the ties, he advocated the use of chemical preservative processes to prevent decay and metal tie plates to prevent wear, the plates being flanges which embed themselves in wood.

The rail, increased in height and weight, will be improved in its material, not perhaps by a return to cold finishing, but either by making the steel lower in carbon (say .20 or .25 instead of .35 and .40), and then tempering them while at a dead red heat in oil by a proper arrangement of the cooling table, a method which would probably not add to the cost of production, or by the substitution of nickel steel now used so extensively for armor plate. Rails of this last material can be furnished at $70 per ton, or about what we were paying for iron when we abandoned the use of that material. The increase in price over the steel rail in use is less than the increase we were compelled to pay in changing from iron to steel. I think there can be no question of the advisability of beginning at once the use of this material in such places as the curves on the New York Elevated Railway, where the steel rails have to be renewed every two or three years, and at many other points where the service is equally severe.

We shall probably continue for fastenings the use of the hook-headed spike, but more should be used along the inner edge of the rail, since the effect of the forces acting upon the head of the rail is to turn it over on its outer flange. The application of the tie-plate will double the effect of the spikes since it compels their acting together.

We may look to see the joint developed along the lines of the Haarmann-Vietor scraf joint, adding greatly to its strength both against the vertical and lateral strains. But the most profitable field for present economy in this particular lies in the lengthening of the rail and the consequent reduction in the number of joints. At the present time a heavy proportion of the rails purchased by the Pennsylvania lines are 33 ft. in length, thus reducing the number of joints by 10%, while a very considerable tonnage has been purchased of 60 ft. lengths, with which extensive experiments are being made. I think we may look with confidence to the adoption of this length as a standard; and if the scarf joint prove a success in solving the difficulties of expansion and contraction, the lengths are likely to be still greater.

The Haarmann-Vietor joint referred to has the rail ends scarfed so that they overlap and are bolted together, the middle joint bolts passing through the rail webs and splice bars. With the rails planed away to half the thickness of web and head, there would be comparatively little value from this arrangement, but Mr. Vietor has invented a rail rolled with an unsymmetrical head, so that when it is scarfed the full strength of the web may be preserved, thus placing two webs of the usual thickness side by side and bolting them together and to the splice bars. We shall illustrate this joint shortly.

TESTING THE COMMERCIAL VALUE OF STEAM COALS.

By Chas. A. Hague, M. Am Soc. M. E.

A few years ago the writer was called upon to determine the commercial value of eight different lots of bituminous coals, used for steam purposes; and as the conditions were exceptionally good for treating the subject upon its merits, great care was taken to secure accurate data. The coals varied greatly in their market price, and the principal object in view was to determine which coal, considering its price and the quantity required to develop a given power, would give the lowest coal bill to the owner of the plant. The result showed that the coal lowest in price was not the cheapest to use, and showed also that the coal producing the power with the least amount consumed was too high in price to compete with some of lower economy.

The plant utilized as a medium for comparing the coals consisted of a 28×60 vertical Corliss engine, non-condensing, and averaging during the trial 280 I. HP. Steam was supplied by three horizontal return-tubular boilers, each 60 ins. in diameter and 16 ft. long, each boiler containing 48 4-in. tubes and having 33 sq. ft. of grate surface. The boilers were set in the ordinary way, heat returning through the tubes, and without any flue over the top.

A Berryman feed-water heater, a Friedman injector and an Edson recording steam gage completed the outfit. Two indicators were used, of the old Richards pattern, and as the engine made only 50 revs. per minute, they answered very nicely.

Great care was used in fitting up the indicator connections. Motion was derived from the engine cross-head by means of a wrought iron lever about 6 ft. long. At the fulcrum end of the lever was formed a sort of wrist plate, into which was secured two steel pins, so located as to give a fair lead-off for each end of the steam cylinder, and to make indicator diagrams about 4½ ins. long. Solid

wrought iron rods of ⅜ round iron, extended from the steel pins to each end of the steam cylinder, near enough to have the hook at the ends of the cords on the indicators attach directly to three ⅜-in. rods. The rods were properly guided at intervals, and their steadiness and precision of movement left nothing to be desired. Eyes were formed at the ends of the rods, so that hooking and unhooking the indicators was easy and convenient. It was found upon experiment that 600 cards per day could be comfortably taken from each end of the cylinder if desired. The diagrams were taken upon metalized paper by pointed brass pencils, and there is every reason to believe that the indicator cards were up to the most exacting requirements for accuracy.

The trial of each kind of coal extended through four working days of ten hours each, making a duration of 32 days for the whole test. The boilers were handled, as in regular daily use, by the usual attendants, and, in fact, the different coals were treated under regular conditions of daily work, no better or no worse, so as to make the trial as practical as possible.

During one day of the run on each kind of coal, 200 indicator cards were taken, and for the balance of the time 100 cards were taken daily, both at regular and at irregular intervals. The power was so nearly uniform that the difference in the cards was immaterial, the principal differences being at the beginnings and ends of the half days, for a few minutes, when the line shafts and the machines were driven without work being done. The cards were measured by a planimeter and the power carefully averaged, the results being based upon coal consumed per horse power per hour.

The trials were made in the autumn, and the weather throughout was exceptionally good; in fact, the conditions all round were ideal, and the writer considers the comparisons as nearly equitable as it is possible to obtain. The recording gage showed that the steam pressure varied but little, and the initial pressure upon the indicator cards was probably as close to the boiler pressure as can ordinarily be obtained in regular practice. The throttle valve was kept wide open, the engine being controlled by the automatic cut-off. The revolutions were carefully timed, both at regular and irregular intervals, and the speed was found to average 50.2 revs. per minute and to vary within very narrow limits, being practically uniform. The engine governor was driven directly from the crank shaft by gearing, no belt being used; and in addition to the regular water or oil pot usually employed, the writer fitted a small leather-lined clamp upon the regulator rod.

The kinds of coal tested were: Wilmington; Park County; Hocking Valley; Brazil; Kincade; Currysville; Gartsherry and Laurel Hill.

Wilmington being the most commonly used and a sort of standard in the market, it was taken as the standard of comparison, and marked 100%. Then as the other coals varied in quantity required per horse power per hour above or below Wilmington, they were marked the corresponding percentage, so that the result showed as stated, just what percentage in weight compared with Wilmington was required under similar conditions for other coals. The following was the result:

Kind of coal.	Per cent. burned per I. HP. hour.
Wilmington	100
Park County	105
Hocking Valley	97
Brazil	87
Kincade	78
Currysville	91
Gartsherry	86
Laurel Hill	72

At the time the above trials were made the price of Wilmington coal was taken at $3 per ton, and to ascertain what we could afford to pay for the other coals, it was only necessary to divide the cost of Wilmington coal by the percentage opposite the coal wanted. This gave the following table of values; that is, when Wilmington is worth $3 per ton, the other coals are worth the amounts opposite them in the table:

Kind of coal.	Value per ton.
Wilmington	$3.00
Park County	2.85
Hocking Valley	3.90
Brazil	3.45
Kincade	3.85
Currysville	3.30
Gartsherry	3.50
Laurel Hill	4.17

To make a practical use of the above values it is only necessary in comparing the coals given to multiply the market price at any time by the percentage opposite the names of the coals in the percentage table, and the lowest result will indicate the cheapest fuel.

Under the conditions observed about 5 lbs. of Wilmington coal was burned per horse power per hour, and the amounts for the other varieties may be obtained by multiplying 5 by the percentage opposite the coal selected. By this method Park County coal was found to be the least efficient, 5.25 lbs. per I. HP.-hour being its record, and Laurel Hill the most efficient, 3.6 lbs.

At the time of these trials the market was such that Brazil coal, which showed a consumption of 4.35 lbs. per HP.-hour, was the cheapest fuel.

STATISTICS OF MINERAL PRODUCTION IN THE UNITED STATES.

The accompanying table, for which we are indebted to the "Engineering and Mining Journal," shows in a form most convenient for reference the principal mineral productions of the United States and their value for the years 1892 and 1893. The falling off of mineral production in both quantity and value is a striking feature of the table; and yet, considering the extent of the financial disturbance which visited the country last summer, the wonder really is that so small a decline in values and quantity of production resulted.

The statistics given are claimed by the author, Mr. Richard P. Rothwell, M. Am. Inst. M. E., to be the most accurate attainable, the returns from which they are made up having been collected for "The Mineral Industry," an annual statistical publication by our esteemed contemporary, which we have before noticed with favor. From the editorial accompanying the table we extract the following interesting statement concerning the rapidity with which the United States has reached the position of the greatest mineral producing nation in the world:

The growth of the mineral industry of the United States has been so rapid as to be wholly beyond comparison with any other nation. Fifty years ago this country began to take rank as one of the important producers. In 20 years it had won a position among the leading nations, and now it not only exceeds all others but the value of its products is almost as great as the value of the combined output of Great Britain, France and Germany.

Such a growth is phenomenal. In 1864 the United States with an output of 22,860,000 metric tons stood third among the coal producing nations, Great Britain leading with over 90,000,000 tons, and Germany, 25,000,000. In the 30 years since that time Great Britain has a little more than doubled its output, Germany has trebled, but the United States has increased eight times and produces now almost as much as Germany and all the rest of the world taken together, excepting only Great Britain. In the production of pig iron our growth has been even more remarkable. In 1865 the pig iron producing countries ranked with Great Britain first, then France, Germany and the United States; Great Britain alone producing six times as much as

THE MINERAL PRODUCTION OF THE UNITED STATES, 1892 AND 1893.

No.	Product.	Customary Measures.	1892 Quantity. Customary Measures	1892 Quantity. Metric Tons.	1892 Value at Place of Production.	1893 Quantity. Customary Measures	1893 Quantity. Metric Tons.	1893 Value at Place of Production.
1	Asbestos	Short tons	100	91	$5,000	120	109	$6,000
2	Antimony Ore	" "	850	771	51,000	850	771	41,000
3	Asphaltum and asph't rock	" "	47,040	42,675	254,016	34,944	31,701	174,720
4	Barytes (crude)	" "	28,476	25,833	142,380	26,632	24,161	133,160
5	Bauxite	" "	9,800	8,891	49,000	11,041	10,106	55,205
6	Borax	Pounds	12,538,196	5,687	940,365	8,699,000	3,946	652,425
7	Bromine	"	379,480	172	64,512	348,399	158	87,100
8	Building Stone				44,589,500			(f)40,000,000
9	Cement, hydraulic	Barrels of 300-400 lbs.	8,211,181		5,909,150	7,503,385		5,180,797
10	Cement, Portland		547,440		1,153,600	586,531		1,152,829
11	Coal, anthracite	Long tons	46,850,405	47,352,696	89,727,982	48,044,834	48,818,356	93,091,670
12	Coal, bituminous (c)	" "	114,220,101	116,059,645	124,230,532	113,436,871	115,263,204	118,305,854
13	Coke	Short tons	12,010,829	12,204,203	23,421,117	9,792,330	9,949,986	14,988,495
14	Cobalt oxide	Pounds	8,600	*3,900	6,450	3,801	*1,766	3,500
15	Copperas	Short tons	13,250	12,021	11,272	16,000	14,515	95,440
16	Copper sulphate	Pounds				54,000,000	24,492	1,822,500
17	Corundum	Short tons	1,504	1,364	139,994	1,747	1,585	140,589
18	Chrome ore	Long tons	1,650	1,677	16,500	1,620	1,646	16,000
19	Feldspar	" "	16,000	16,258	80,000	17,000	17,274	85,000
20	Flint	" "	37,000	37,536	185,000	38,000	38,612	190,000
21	Fluorspar	Short tons	9,000	8,165	54,000	9,700	8,800	63,050
22	Grindstones	" "			304,800	45,580	41,350	345,920
23	Gypsum	" "	256,250	232,438	695,492	250,000	226,799	562,500
24	Infusorial earth and tripoli	" "	1,323	1,200	41,950	1,709	1,550	46,800
25	Lime	Barrels, 200 lbs.	70,000,000	6,350,200	38,500,000	60,000,000	5,443,164	30,000,000
26	Limestone for iron flux	Long tons	4,560,000	4,633,416	2,097,600	3,750,000	3,810,375	2,250,000
27	Magnesite	Short tons	1,402	1,272	9,814	1,143	1,037	8,000
28	Manganese ore	Long tons	19,117	19,425	129,586	9,150	9,297	60,000
29	Marls	Short tons	125,000	113,400	65,000	110,000	99,792	55,000
30	Mica	Pounds	75,000	34	100,000	75,000	34	100,000
31	Millstones				20,000			18,000
32	Mineral Paints	Long tons	50,000	50,805	650,000			546,000
33	Natural gas				14,800,000			14,000,000
34	Onyx	Cubic feet	3,500		40,000	2,175		28,750
35	Ozokerite (refined)	Pounds	130,000	59	7,800	None.		
36	Petroleum	Bbls. 42 gals.	50,512,136	7,000,982	30,229,128	50,249,228	6,978,403	30,223,505
37	Phosphate rock	Long tons	902,723	917,257	3,322,021	981,340	997,140	3,434,690
38	Plumbago (crude)	Short tons	900	816	3,500	1,500	1,365	7,500
39	Plumbago (refined)	Pounds	1,398,363	634	87,902	896,603	406	39,503
40	Potters' clay	Long tons	450,000	457,349	1,000,000	393,000	399,327	830,000
41	Precious stones				188,000			200,000
42	Pyrites	Long tons	106,250	109,957	357,000	95,000	96,526	285,000
43	Salt	Barrels, 280 lbs.	11,784,954	1,542,133	5,900,000	11,435,487	1,452,388	5,717,743
44	Slate (for pigment)	Short tons	3,400	3,085	21,000	3,000	2,721	18,000
45	Slate (for roofing)	In squares	953,000		3,396,625	871,500		2,780,600
46	Slate (other kinds)				750,500			737,400
47	Soapstone	Short tons	23,208	21,054	423,449	20,100	18,235	366,825
48	Soda, natural	" "	3,300	2,994	16,500	2,500	2,268	12,500
49	Soda, natural sulphate	" "	1,680	1,524	8,400	90	82	450
50	Sulphur	" "	1,825	1,656	54,750	1,344	1,219	26,880
51	Talc (fibrous)	" "	41,925	38,034	472,485	36,500	33,113	337,625
52	Venetian red	" "	4,205	3,815	89,335	3,839	3,475	81,475
53	Whetstones (g)	Gross pounds	1,099,000		107,580	900,000		105,925
54	Zinc, white	Short tons	27,500	24,946	2,200,000	25,000	22,678	1,875,000
	Total non-metallic				306,610,582			371,376,935
	METALLIC							
55	Aluminum, value at N. Y. (b)	Pounds	295,000	134	191,750	312,000	142	202,800
56	Antimony, value at S. Fran.	Short tons	200	181	36,000	350	318	63,000
57	Copper, value at N. Y.	Pounds	325,500,000	147,647	36,716,400	322,585,500	146,324	34,677,940
58	Gold, coining value	Troy ounces	1,596,375	*49,652	32,997,071	1,739,081	*54,091	35,950,000
59	Pig iron, value at N. Y.	Long tons	8,977,869	9,122,413	134,668,035	7,043,384	7,156,782	93,898,309
60	Lead, value at N. Y.	Short tons	205,630	186,548	16,450,400	193,928	175,931	14,467,029
61	Nickel (fine)	Pounds	96,152	*43,614	57,691	25,868	*11,745	12,429
62	Platinum (crude)	Troy ounces	350	*11	1,750	300	*9.3	9,300
63	Quicksilver, value at S. F.	Flasks, 76½ lbs	27,993	971	1,119,720	30,164	1,046	1,108,527
64	Silver, coining value	Troy ounces	65,000,000	*2,022,195	84,038,500	60,500,000	*1,881,732	78,230,450
65	Spiegeleisen and ferroman	Long tons	179,131	182,015	h 6,647,290	81,118	82,424	2,893,329
66	Tin	Pounds	143,400	65	29,827	None		
67	Zinc, value at New York	Short tons	84,082	76,279	7,785,993	76,255	69,178	6,214,782
	Total metallic				330,740,427			267,707,795
	Est. prod'ts, unspecified				f 7,500,000			f 6,000,000
	Grand total				724,821,009			645,084,730

(f) Estimated. (g) Includes scythestones and novaculite. (h) Value taken as average of spiegel-eisen and ferromanganese, assuming production to have been one-third ferromanganese. (i) Including nickel in copper-nickel alloy and in exported ore and matte. (j) The production of petroleum stated in gallons is calculated in kiloliters, and converted to metric tons, by multiplying by 0.88. This gives an approximate result, the specific gravity of the various kinds of oils varies. * Kilograms.

the United States. But in 1892 the United States output was more than 11 times as much as 30 years before, and almost half as much again as Great Britain; as much as Germany, France, Belgium and Austria-Hungary all together; or, as Great Britain, France and Austria-Hungary. These two staples, iron and coal, serve to show our quick rise to supremacy as a mineral producing country.

PUMPING WATER FOR IRRIGATION IN ARIZONA.

Various causes have contributed to the adoption of pumping as a means of securing water for irrigation in a number of places in the West. Of course the most obvious cause for resorting to the use of pumps is absolute inability to get water upon the land in any other way, the water either being developed in a non-flowing well or the land to be irrigated lying high above a stream. In addition, it may sometimes happen that the cost of necessary storage works in the mountains or for long conduits, or both, would be more expensive than a pumping plant, or an independent farmer may prefer to run a small pump rather than pay a company a high price for water.

Some pumping plants for irrigation located in Arizona are described in Bulletins 10 and 11 of the Agricultural Experiment Station of the University of Arizona, located at Tucson. Two plants located at or near Yuma, Ariz., each drawing water from the Colorado River, are described in Bulletin 11 by Messrs. F. A. Gulley, Director, and Charles B. Collingwood, Chemist of the station.

The first of these plants to be described in the bulletin was built by the Yuma Water & Light Co. and delivered water to crops during the season of 1893.

The climate of Yuma and vicinity is remarkable. On this point and regarding the crops that may be raised in that section the authors state:

> With possibly one or two exceptions this region has the least rainfall, the greatest number of days of bright sunshine, the dryest atmosphere and the most regular warm winter temperature of any place in the United States. It also has for irrigation purposes the largest and most constant flowing river in the arid belt. The water supply of the Colorado River is sufficient at all times in the year to irrigate several hundred thousand acres of land, but until recently the difficulty of getting the water out on the land has discouraged the investment of capital in improvement.
>
> In the city of Yuma, and on ranches in the vicinity, oranges, lemons, limes, figs, dates, grapes and other fruits, all of the finest quality, have been grown for some years in a small way, and without special skill or attention these fruits have ripened earlier than the earliest of the California productions. A variety of vegetables have also been planted, and it has been found that these could be matured at any time during the winter and spring.

In 1890 the Experiment Station established a branch on the Gila River, some 13 miles above Yuma, where a pumping plant had been put, but floods and consequent damage led to the abandonment of the plant. In 1892 the work was continued on the Yuma Heights property, a tract of mesa land one mile south of Yuma and some 80 ft. above the mean level of the Colorado River. This site was selected, it appears, in co-operation with the Yuma Water & Light Co., of which Mr. H. W. Blaisdell is manager. This company concluded to put in a pump to force water from the river to the mesa where it owns 3,000 acres of land. Aside from pumping, the only way of getting water to this land would have been to build a high dam across the river or carry a canal a long distance up the river, either of which was deemed too expensive for the results to be obtained. But the mesa was thought to be so well fitted for raising tender and early fruits and vegetables that the expense of raising water even to a height of 80 ft. would be warranted. The bulletin states that "this company may be said to be the pioneers in the use of high duty pumping machinery for irrigation purposes."

The pumping plant is located in the town of Yuma, and consists of two 150-HP. boilers, an 18 × 42-in. Brown automatic cut-off condensing engine of 165 HP., and an Allis double-acting plunger pump, 17 × 42 ins., with a daily capacity of 12 cu. ft. of water per sec. (600 miner's inches) or 8,000,000 gallons per 24 hours, with the engine flywheel making 67 revolutions per minute. The plunger speed is very high, 468 ft. per minute, but is said to give good results.

A year's test has shown that to lift 8,000,000 gallons of water 80 ft. in 24 hours requires 10 cords of good mesquite wood, which costs $3.50 per cord at the station. This is at the rate of $4.37½ per million gallons raised 80 ft., or about 5.4 cts. per ft. raised, for fuel alone. Or to put it another way, the cost of fuel is 5.89 cts. per miner's inch. Of course labor and incidentals, together with interest and depreciation on the pumping plant, pipe system and reservoir, must be taken into account, after which the proposed charge of $12 per year for 2½ acre-feet of water (109,000 cu. ft., or 817,000 gallons) or 20 cts. per day per miner's inch (12 cu. ft. per sec. while supplied) might be considered reasonable.

The water passes from the river to a settling basin and from the pumps through 2½ miles of 26-in. redwood pipe, banded with steel rods, with 80 ft. rise, to the mesa. A 1,000,000-gallon reservoir has been built on the mesa to store water for use when the pumps are not working. The company, as may be inferred from its name, supplies light to the town.

The amount of water allowed for irrigation, 2½ acre-feet per year, is said to be double that used for fruit trees over a considerable part of California, and may be more than will be required at Yuma after the start. The soil of the mesa is a sandy loam, from 4 to 20 ft. in depth, well adapted to the use of Colorado River water, which carries a large amount of fine matter in suspension. An average of analyses of Colorado River water taken daily at Yuma for 17 months, together with the estimated fertilizing value of the ingredients, is given in the bulletin, as follows:

	Pounds per acre-foot.	Value, cts.
Lime, mostly carbonate	540.0	..
Nitrogen, at 14 cts. per lb	6.3	88.2
Phosphoric acid, at 7 cts	13.8	96.6
Potash, soluble in cold water, at 6 cts	10.2	61.2
Potash, insoluble in cold water (estimated) at 2 cts	48.0	96.0
Fertilizing value, one acre-foot of water		$3.42

At the above rate of value the authors of the bulletin state that the 2½ acre-feet of water for which it is proposed to charge $12 would contain $8.55 worth of fertilizers, which is nearly two-thirds the cost of the water. In addition, the clay carried by the water will gradually change the sandy character of the mesa land.

Ten acres of land on the heights were planted with good results to various fruits and vegetables under the general direction of the Experiment Station. The Yuma Water & Light Co. has planted an experimental orchard of 110 acres, 10 of a kind, including oranges, lemons, limes, peaches, apricots, plums, prunes, figs, and grapes. The vines and trees will come into bearing in 1896.

A brief note is given in this same bulletin regarding the pumping plant of the Colorado Irrigation Co., which supplies water to Colorado River bottom land below Yuma. In 1893 the pumping plant consisted of a No. 15 centrifugal pump and a 45-HP. Westinghouse engine and boiler. At normal low river the water is lifted 16 and at the average stage 11 ft. and emptied into a canal. The pump has a capacity of 13½ cu. ft. per sec., or 6,000 gallons per minute. The enterprise was started in 1891 and fruit trees were planted in 1892.

In Bulletin 10, Director Gulley describes some experimental work at Willcox, Ariz. Here the Experiment Station has been doing some work in co-operation with and at the expense of the Willcox Agricultural & Improvement Co., which company was organized by several citizens to test the soil and the sub-surface water of the Sulphur Spring Valley.

A well 8 × 16 ft., some 24 ft. deep, was sunk two miles from Willcox and a No. 3 centrifugal pump, driven by a 10-HP. engine, put in. The pump has a capacity of ⅔ cu. ft. per sec., or about 430,000 gallons per day. With a fuel consumption of one cord of wood per 24 hours 5⅓ acres can be covered to a depth of 3 ins., which is said to be the usual depth of one watering at that place. With the usual rainfall it is believed that five or six such irrigations per year would be sufficient for alfalfa, four for fruit trees, and two for corn, sorghum and beans.

During the latter part of 1893 the company bought a gasoline engine guaranteed to develop 35 HP. with a consumption of 3½ gallons of gasoline per hour, and a centrifugal pump warranted to lift 2,600 gallons per minute to a height of 35 ft., when run by a 35-HP. engine. At full capacity this engine and pump would lift 3,744,000 gallons of water per day, or nearly 11½ acre-feet, with a consumption of 84 gallons of gasoline, which, at the freight rates then ruling would cost about 20 cts. per gallon, $16.80 per day, or $4.46 per million gallons raised 35 ft., equivalent to 12.74 cts. for fuel alone for each million gallons raised 1 ft. Mr. Gulley states that as gasoline sells for 5 cts. per gallon in the East and for 11 cts. on the Pacific Coast, it is to be expected that a reduction in price could be secured as soon as a considerable quantity was used.

The advantage of the gasoline engine is that it requires comparatively little attendance, so that labor may be employed elsewhere a good part of the time. All expenses taken into account, Mr. Gulley thinks that water in that locality can be lifted from 15 to 40 ft. at a cost not exceeding water rentals at many places in the irrigated belt.

EXTENT OF THE ASPHALT PAVEMENTS OF THE WORLD.

We are indebted to Maj. J. M. Howard, of the Barber Asphalt Paving Co., for the following figures showing the total extent of asphalt paving in Europe and America up to Jan. 1, 1894.

The figures for length of roadway represent not the actual total length of the streets, but the total length of street which the area of paving noted would cover, assuming a uniform street width of 26 ft. The figures for Canada are subject to certain additions for work done and not reported in 1893. The striking fact of the above table is that the Trinidad asphalt paving, which was first introduced long after asphalt limestone paving was laid in European cities, has now about six times the extent that is credited to the European asphalt.

Trinidad Asphalt Pavements Laid in 18 years.		
In the United States	14,401,240 sq. yds.	944 miles
In Canada	269,046 " "	18 "
Grand total	14,670,286 " "	962 "
Asphaltic Limestone Pavements Laid in 40 years.		
In Europe	2,323,413 sq. yds.	151 miles
In United States and Canada	151,000 " "	10 "
Grand total	2,474,413 " "	161 "

It will be noted that all the above paving is of the general class known as sheet asphalt, that is, pavements laid without joints, and the considerable mileage of asphalt block paving which has been laid in this country is not included.

THE TAMPICO JETTIES, MEXICO.

On Aug. 30, 1888, a contract was entered into between Carlos Pacheco, Secretary of State and Public Works for Mexico, and Mr. Sebastian Camacho, representing the Mexican Central Railway Co., to make a deep-water entrance to the harbor of Tampico, Mexico. In June, 1889, Mr. L. C. Wade, then president of the railway company, engaged Mr. E. L. Corthell to make the necessary surveys and plans for the improvement, which plans were formally adopted by the railway company and the Mexican Government in August of the same year. From a recent report of Mr. Corthell to Mr. A. A. Robinson, President of the Mexican Central Ry., and from a recent press interview the following account of this important work is compiled:

Tampico, seven miles from the Gulf Coast, on the Pamico River, lies just half way between the Rio Grande and Vera Cruz. The Mexican Central Railway Co. is now building a railway from Tampico to the City of Mexico, which will have much more favorable grades than the old Vera Cruz-Mexico line, and there is now railway connection west to San Luis Potosi, and northwest to the Mexican International main system.

The fan-shaped watershed of the Pamico River is over 550 miles long and covers about 36,000 sq. miles. The rainfall on this area is variable. At times of general rainfall, like that of the season in July and August, 1893, the flow in the main trunk of the river, just below Tampico, was 150,000 cu. ft. per second, or twice the flood volume passing through the Mississippi jetties. At this point, seven miles from the Gulf, the river is about one-quarter mile wide, over 30 ft. deep, with a continuous 20-ft. channel 800 ft. wide. The cross-section of the river bed is 27,000 to 30,000 sq. ft. and the mean flood velocity is 6 ft. per second, or 4 miles per hour. The sedimentary matter carried down in these floods is enormous in quantity, and

upon leaving the confining banks of the river it spreads, loses its velocity, and is deposited on a bar, varying from 5,000 to 7,000 ft. in distance from the general shore line. On this bar there is a depth of about 9 ft., varying between 5 ft. and 12 ft., according to river and Gulf conditions. The extension of this bar into the Gulf is prevented by powerful littoral currents cutting away in the winter months, when these shore currents are strongest, the accretions brought down by the summer floods. The result has been a generally maintained equilibrium as far as position is concerned.

To cut a way through this bar and to make a channel to the splendid, land-locked harbor within was the work to be accomplished by Mr. Corthell. After careful study of the situation, he located two parallel jetties about 1,000 ft. apart on center lines, giving an effective entrance width of 900 ft. These jetties are about 7,000 ft. long, built with a foundation of brush mattresses, upon which stone was deposited, and this was capped by large rock, built roughly into a rounded vertical section. The north jetty, exposed to the prevailing "northers," is especially substantial.

While work in developing the channel between the jetties through the bar is now well advanced, it was delayed at least a year by two causes. The first of these was the unprecedented drought, extending from June, 1889, to July, 1893; the second was the discovery of an obdurate inner bar, fully 1,000 ft. wide, made up of cakes of conglomerate rock several inches thick, isolated coral formation and several old wrecks. A hydraulic dredge was put to work and the wrecks were blown up by dynamite. When the flood of July, 1893, came this inner bar was entirely removed and the channel across the bar was deepened, widened and straightened through its entire length. The least depth on the cross sections, taken every 100 ft. for the entire length of the jetty, is 27.8 ft.; there is a good navigable channel, with a least depth of 27.1 ft., and the 24-ft. channel is nearly 600 ft. wide for the whole length of the jetty, with contours generally parallel to the jetty walls. Mr. Corthell is pleased that this last flood demonstrated the wisdom of placing the jetties 1,000 ft. apart; had they been nearer they would probably have been undermined.

Immediately outside the ends of the jetties is a temporary sand bar, deposited by the recent flood, which carried about 1-700th part of sediment. It is estimated that the total volume of sediment deposited in one month's time was over 14,000,000 cu. yds. This outer bar has a channel through it of 23 ft. and a good navigable channel of 22½ ft. The bar lies in a favorable position to be removed by the Gulf littoral currents, and as soon as the dredge boat has finally completed its work Mr. Corthell expects that the natural forces of the river will maintain the depth through the jetties.

As a result of this improvement Tampico has already risen from a port of no importance to that of second in the country. The Johnson Line is putting six vessels on the Tampico-Baltimore route; trade with Mobile is flourishing; the Mexican Government has built a $60,000 building to accommodate the customs service there, and the $2,000,000, which the harbor improvements may ultimately cost, is already paying a heavy rate of interest. As railway access to the great Mexican tablelands is easy from Tampico, it is claimed that it will soon be the first Mexican port in importance on the Gulf of Mexico.

The Woodbridge wire-wound gun, which was tested recently at Sandy Hook, is said to have been cracked at the 21st round of 255 lbs. of brown prismatic powder. The tube of the Brown wire-wound gun was only cracked after 216 rounds, but in this gun the tube can be replaced.

A "good roads" convention is announced to be held at Asbury Park, N. J., on July 5 and 6, one of the features of which will be an exhibit of roadmaking machinery. Gen. Roy Stone, head of the good roads bureau of the Agricultural Department, is one of the active promoters of the convention.

The Great Venezuelan Railway, recently completed, connects the cities of Valencia and Caracas, and is parallel with the coast, but on the west side of the high and steep coast range. From each of these towns is a railway to the coast, one from Caracas to the port of La Guaira and the other from Valencia to the port of Puerto Cabello. The line is 114 miles long, though the direct distance is only about half that, the development being in order to keep the grade down to 2%. The road was built by a German company, and cost about $20,000,000. From Caracas the line ascends to Los Teques, which is the summit, 4,021 ft. above sea level, with a tunnel 900 ft. long, the largest of the 86 tunnels on the line. The road then descends to the valley and encounters no great engineering difficulties. There are 200 bridges and viaducts, the latter being mainly on the American plan, with riveted deck trusses and iron trestle towers. The track consists of T-rails on steel ties laid in gravel and sand ballast, and the gage of 3 ft. 6 ins. was adopted, probably because that is the gage of the other roads of Venezuela, built under the somewhat common misapprehension that a reduction in the gage necessarily means a reduction in cost of construction. The locomotives are 35-ton tank engines, built in Germany, and the cars are built on the American plan. Mr. Arnold Ruge, of New York, was engineer for the contractors, Schadler & Camp.

Municipal ownership of street railways seems to be increasing in Great Britain, and the city authorities of Newport are now advertising for tenders or offers of rental for the working by horse traction of an existing line, and extensions about to be constructed (consisting of about three miles of line in the most populous part of a busy commercial town, having a population of about 60,000), upon the following conditions: 1, a lease to be granted for 21 years, determinable at the option of either party at the end of 7 or 14 years; 2, if the lease be determined at the end of 7 or 14 years, of which six months' previous notice must be given, the city to be liable to take over, at a valuation, all the lands, buildings, rolling stock, horses and plant used by the lessees in the proper working of the line; 3, the lessees to work the line, more particularly as to service and running of workmen's cars, in accordance with the reasonable requirements of the city. The railway will remain vested in the city, and to be kept in good repair by it and at its expense. All rates, taxes and other outgoings to be paid by the lessees. The lessees are to undertake the working of any additional lines which may be constructed by the city, upon terms to be arranged, or, failing agreement, to be settled by arbitration. The existing tramways have been worked for the past 21 years by the Newport Tramways Co., whose powers will shortly expire, and the dividends paid by them during the past five or six years have been at the rate of 10%. The city is about to construct the extensions and to reconstruct the existing lines.

Railway velocipedes or tricycles are common enough in this country, but a rather novel form used in Russia has a large and small wheel on one rail and a very small wheel on the other rail. The driver sits over the large wheel, as in the old-fashioned bicycle, and propels the machine by hand levers and treadles.

The use of Australian gum wood for paving blocks in this country is suggested by Mr. D. W. Maratta, U. S. Consul-General at Melbourne, in a recent consular report. He considers that the best timber obtainable for this purpose is the Tasmanian blue gum, which has worn in Melbourne for six or eight years, and during that time no repairs have had to be made, and the pavements are as good now as when laid. The Tasmanian government is interested in the matter, and has taken active steps to place samples before our contractors and municipal authorities. Samples of the blocks have been sent to Trowbridge & Terry, of New York. While the cost of freight, etc., would bring them to New York at a price probably considerably higher than cedar blocks can be obtained, consideration must be given to their durability and vast superiority, and Mr. Maratta suggests that arrangements might be made to admit these blocks free of duty. The Australian jarrah and karri wood blocks have been considerably used for paving in London, and have shown a durability far in excess of any other wood blocks ever tried. Some objection has been found, however, to them on account of their slipperiness; and it is said that they are even so hard as to make the street noisy. (See Eng. News, March 29, 1894.)

The Nicaragua Canal works appear to be in bad condition, judging from published reports by persons who have recently visited them. The channel dredged for about half a mile is said to be filling up, the dredges rusted away so as to be practically useless, the construction track dilapidated and the breakwater rotting away. The buildings and machine shops are said to be still in good condition. Much of the property has been sold, illegally it is claimed, by order of the Nicaraguan courts, to satisfy creditors of the company.

A "silicate" sewer and water pipe has been placed on the market by J. B. Parker & Co., of Los Angeles, Cal., which is claimed to be superior in several respects to the best kinds of cement and vitrified clay pipes for pipe sewers. This "silicate" pipe is made by fusing together at a temperature of about 800° F. 65% of clean, sharp sand, 20% of sulphur, and 5% of some material which will act upon the sulphur and permit it to be heated above the normal point of combustion for sulphur without combustion taking place. Sometimes the proportion of sand is reduced to 60% and 5% of asphaltum is added to the other materials. The anti-combustive material used is a mixture of sal-ammoniac, litharge and English whiting in equal proportions. The several ingredients are placed in an iron vessel in layers, the sulphur at the bottom, and on top of this the anti-combustive, and then the sand, and raised to a temperature of about 800°. After being thoroughly fused the mixture is rapidly cooled by a current of air to 250° to 240° F., when it is in a plastic condition and can be cast in molds like cast iron pipe. The casting process, of course, permits egg-shaped sections to be manufactured as easily as circular sections. Tests show the tensile strength of this "silicate" to run from 546 to 820 lbs. per sq. in., with an average of 650 lbs. per sq. in., and its compressive strength to be about 3,000 lbs. per sq. in. The material is stated to be a perfect electric insulator and to be unaffected by the strongest acids. Its surface is very smooth. The joints are made by cementing them together with the silicate, which is easily worked with a trowel at 240° F. From 3 to 12 ins. diameter the pipe is made in 4 ft. lengths; 14, 16 and 18 ins., in 3½-ft. lengths; 20 to 22 ins., in 3-ft. lengths; and from 22 to 30 ins. in 2-ft. lengths. The cost of this pipe per foot is from two to five times that of vitrified clay pipe, depending upon the size, being for 12-in. pipe 75 cts.; for 16-in., $1.25; for 18-in., $1.50, and for 24-in., $2.45 per lin. ft. The pipe is manufactured by J. B. Parker & Co., of Los Angeles, Cal., S. O. Wood, Consulting Engineer.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BUFFALO, ROCHESTER & PITTSBURG.—Press reports state that surveys will soon be made for a branch from Pike Station to Pike, N. Y., 4½ miles.

NEW YORK, ONTARIO & WESTERN.—It is stated that the construction of an extension to the state reformatory, in the town of New Paltz, N. Y., will soon be commenced.

Projects and Surveys.

COLUMBUS, HOCKING VALLEY & ATHENS.—The bill authorizing the lease of the Columbus & Hocking canal bank from Carrol to Athens, to this company for a right of way for its proposed railway, has been passed by the Ohio legislature. The company is to pay $50,000 cash and $10,000 per year. E. M. Paster and G. W. Lamb, of Columbus, are interested.

ELKTON & SOUTHERN.—Subscription books for the capital stock of $350,000, will be opened at Elkton, Md., in June. This project is an opposition line to the projected Elkton, Massey & Middletown branch of the Pennsylvania, now being surveyed. The proposed route is from Childs south to Elkton, Caesapeake City, St. Augustine, Cecilton, Fredericktown, Galena, to Lambson's, on the Baltimore & Delaware Bay, a distance of 25 miles. The present directors are: George Biddle, David P. Davis, Z. Porter Lusby, John J. Williams, George N. Bennett, John S. Wirt, W. H. Mackall, Manly Drennen and Dr. Howard Bratton, of Elkton, Md.

Southern—Existing Roads.

CHARLESTON, CLENDENNIN & SUTTON.—Efforts are being made to extend this railway about 100 miles to Sutton, Braxton county, W. Va., on the West Virginia & Pittsburg. The line is now completed from Charleston, W. Va., to the mouth of Big Sandy Creek, 22 miles, and the projected extension would give the Kanawha Valley a new and short route to Pittsburg. Governor Wm. A. MacCorkle, of West Virginia, is interested.

DARIEN & WESTERN.—Incorporated to complete the Darien Short Line to a connection with the Florida Central & Peninsular, about 20 miles from Darien, Ga. About 22 miles of the road were reported as completed a year ago. James Walker, R. W. Grubb, H. S. Ravenel, and Geo. E. Atwood, Darien, Ga.; W. F. Cochran (Pres.), G. D. McKay (Treas.), and W. G. Morse (Secy.), Yonkers, N. Y.

Projects and Surveys.

BUCKHANNON, TYGART'S VALLEY & POINT PLEASANT.—It is stated that the construction of this railway will soon be commenced from Belington to Buckhannon, W. Va., 18 miles.

WEST VIRGINIA.—J. S. Casement, Painesville, O., is said to have contracted with owners of large tracts of land along Big and Little Coal rivers, in the southern part of this state, to build about 50 miles of railway in that region.

Northwest—Existing Roads.

BALTIMORE & OHIO.—A press report from Omaha, Neb., states as follows: Omaha business men are assured by Chicago officials that the Baltimore & Ohio will certainly build to Omaha before the end of this year. The project is not a new one, and the assertion that the road is coming is made in spite of the denials telegraphed from Baltimore. It is proposed to build about 90 miles in Illinois, connecting Beardstown with Quincy, and to build about 20 miles in Missouri, connecting Trenton with Pattonsburg. Beardstown is the present northwest end of the Baltimore & Ohio, as St. Louis is its southwest end. By building across the gap from Beardstown to Quincy, the trunk road would reach the Quincy & Pacific, now a non-paying road extending from Quincy to Trenton. Bridging the gap from Trenton to Pattonsburg, the end of the Omaha & St. Louis (old Wabash) would make another non-paying road useful.

DULUTH, PIERRE & BLACK HILLS.—Jas. A. Ward, Man., Pierre, S. Dak., writes us that 91 miles of this road have been graded and it is hoped to begin and complete the tracklaying this year. The route is from Aberdeen to Pierre, S. Dak., 130 miles; mostly level prairie. Engr., Robert P. Humphrey, Pierre, S. Dak.

Southwest—Existing Roads.

GULF, BEAUMONT & KANSAS CITY.—Contracts for 30 miles of additional construction will be awarded about Aug. 1, according to reports. It is expected that the line will be completed from Beaumont, Tex., to Brama, 40 miles, by July 1. Vice-Pres., John H. Kirby, Beaumont, Tex.

ILLINOIS CENTRAL.—Press reports state that this railway will soon be extended from Natchez, Miss., to Alexandria, La., about 70 miles, to connect with a line to be built from Galveston, Tex., to that city. The citizens of Alexandria, La., have appointed M. C. Mosely, E. H. McCormick and Julius Levin, a committee to secure the building of the road.

RED RIVER & SOUTHWESTERN.—W. J. Swain, Henrietta, Tex., writes us that the road is graded from Henrietta to Archer City, 35 miles, and that the proposed route is from Red River, in Clay county, to Henrietta, Archer, Throckmorton, Albany, Abilene and Baltinger, to Spofford Junction, 325 miles. Arrangements have been made to begin active work within 30 days for completing the line between Henrietta and Archer City, and the gap between Henrietta and Red River, 12 miles in length. Contractor, Thomas Clay, Kansas City, Mo. Engr., Wm. Waltham, Dallas, Tex.

TEXAS, LOUISIANA & EASTERN.—W. C. Beach, Supt. and Ch. Engr., Conroe, Tex., writes us that the receivers of this company have requested permission to extend the line northeast about five miles to the Trinity River, and that the road will probably be built in time for the fall business this year. The work will be fairly heavy, 15,000 cu. yds. per mile, with 1% grades and a maximum curvature of 6°. The principal source of traffic is lumber. The contract for the construction has not been awarded.

TEXAS MIDLAND.—E. H. R. Green, Pres., Terrell, Tex., writes us that the contract for constructing 20 miles of the extension north from Roberts, Tex., has been awarded to the Bethume-Craney Construction Co., Kansas City, Mo. The construction will be commenced at once.

Projects and Surveys.

JEFFERSON AVENUE.—Organized by the residents of Jefferson parish, La., to build steam dummy railway from Carrollton, to near the site of the proposed bridge across the Mississippi River; capital stock, $500,000; Pres., Wm. H. Louque; Secy. and Treas., Octave Besancon; Supt., Wm. Cummings.

MEMPHIS, HEBER SPRINGS & NORTHWEST ARKANSAS.—Press reports state that this company, noted May 10, will soon be ready to award contracts for constructing 32 miles of its proposed road. Pres., J. R. B. Moore, Heber, Ark.

OKLAHOMA.—Incorporated in Kansas to build a railway from Arkansas City, Kan., through Oklahoma to Eagle Pass, Tex.; capital stock, $1,500,000; principal office, Arkansas City, Kan.; directors, H. Stout and L. F. Hoops, Arkansas City, Ark.; C. M. Bay, Kingman, Kan.; S. Parker, New York; W. N. Brayton and G. Y. O'Neal, Parker, Ind. T.; C. M. McClellan, Tulala, Ind. T.

PALESTINE & DALLAS.—G. W. Burkitt, Pres., Palestine, Tex., writes us that the construction of this proposed railway between Palestine and Dallas, Tex., about 100 miles, will not be commenced for probably two months.

TEXAS.—The Southwest Texas Plant & Seed Co., Aransas Pass, Tex., is reported as to build a branch railway to connect its property with the San Antonio & Aransas Pass.

VELASCO & NORTHERN.—E. L. Parry, Secy., Velasco, Tex., writes us that contracts will probably be let this fall for constructing this railway from Velasco, Tex., to Brazoria, Columbia, Rosenburg, about 55 miles. The surveys have been completed and 4,000 acres of land and $50,000 secured toward the construction. Ch. Engr., R. J. Donaldson.

Rocky Mt. and Pacific—Existing Roads.

ELK MOUNTAIN.—It is stated that the construction of this railway in Colorado will soon be resumed.

GREAT SALT LAKE & HOT SPRINGS.—H. S. Joseph, Ch. Engr., Salt Lake City, Utah, writes us that an extension from Centerville to Farmington, 1 mile, has been partially graded and extensions surveyed from Centerville to Coalville, 53 miles, by way of Ogden Junction and Weber Canyon, and from Ogden Junction to Ogden, 10 miles, and for 150 miles to the Deep Creek mining regions, by way of Sandy Smelters. The work will include a 1,500-ft. tunnel at Ogden Summit. The maximum grade of the Coalville extension will be 1.1% and the maximum curvature 6°. The date of awarding contracts has not been decided upon.

SAN PETE VALLEY.—Press reports state that a meeting of the stockholders has been called to vote on changing the gage of this road to broad gage and to arrange for extending the line northward to Salt Lake City and southwest to a connection with the Nevada Southern, now being built northward from a point on the Atlantic & Pacific. Pres., Theo. Bruback, Salt Lake City, Utah.

Projects and Surveys.

CEDAR CITY TERMINAL.—W. C. Hardy, Ch. Engr., Salt Lake City, Utah, writes us that the right of way has all been obtained for this proposed railway from Cedar City up Coal Creek Canyon, a distance of 7 miles. The principal source of traffic would be coal. The company was chartered Jan. 29, 1894. Pres., W. W. Cluff, Coalville, Utah.

PUEBLO, GUNNISON & PACIFIC.—H. R. Holbrook, Ch. Engr., Pueblo, Colo., writes us that contracts for constructing this railway will be awarded after the panic is over. The line has been located 50 miles south of Pueblo to the Huerfano River. The work will be light.

OVERLAND PACIFIC.—Incorporated in California by the directors of the Fort Bragg, Eureka & Round Valley Ry. Co., to build a railway about 100 miles in length and connecting Fort Bragg, Willets and Ukiah; estimated cost, $2,083,215; capital stock, $2,510,000; directors, Barclay Henley and T. L. Johnson, San Francisco; Calvin Stewart, Fort Bragg, Cal.; G. W. Hunt, Walla Walla, Wash.; and R. S. Strahan, Portland, Ore.

STREET AND ELECTRIC RAILWAYS.

WATERPORT, N. Y.—The Waterport Electric Light & Power Co. has been organized with a capital stock of $40,000, by Capt. Lina Beecher and others. It is proposed to construct at once a single-rail electric railway between this place and Lakeside, a distance of 3½ miles.

VICKSBURG, MISS.—It is expected that work will soon be commenced by the Vicksburg Electric Transit & Lighting Co. on a street railway and lighting plant to cost $100,000.

CLEVELAND, O.—The directors of the proposed electric railway between this city and Akron have decided to engage an engineer to make surveys, as soon as the right of way and the remaining $20,000 have been secured. Capt. T. K. Dissette is interested.

CUYAHOGA FALLS, O.—Work is reported as having been commenced on the electric railway from Barberton to this place, a distance of 11 miles, noted last week.

GOSHEN, IND.—Press reports state that the Cosmos Co., Chicago, representing J. J. Burns, J. H. McIlhenry, and K. G. Ripley, have secured the franchise of the Goshen Electric St. Ry. Co., and propose to connect this city and Elkhart by an electric railway, and run a spur from there to New Paris, where it will connect with the Wabash Ry.

HAMMOND, IND.—It is reported that an electric railway is to be constructed from this city through West Hammond and Burnham and to connect with the Calumet Electric Ry. in Chicago. Thomas Burnham is interested.

ALPENA, MICH.—A petition has been presented by W. P. Williams, W. P. Comstock and others, for a 30-year franchise for an electric street railway.

COLORADO SPRINGS, COLO.—It is reported that D. W. Diggs, St. Louis, Mo., is investigating the feasibility of constructing an electric railway from this city to Cripple Creek.

SHERMAN, TEX.—The electric railway station was burned with five cars May 18; loss, $10,000. It is reported that the company will rebuild at once.

HAMILTON, ONT.—It is reported that the Hamilton Radial Electric Ry. is to be extended to Burlington, and to connect with the Toronto & Minicoline Ry., which is now being extended westward.

HIGHWAYS.

MASSACHUSETTS.—Bids are asked by the Boston water board until June 4 for building two roads in the towns of Framingham and Southborough.

NEW YORK.—It is reported that work will soon be commenced on the proposed road from Highland Station to the state camp grounds at Peekskill, for which $12,000 has been appropriated.

OHIO.—Bids are asked until June 16 for constructing about 9,334 lin. ft. of stone road. H. M. Hause, Clk., Union township, Mount Cory, Hancock county.

ILLINOIS.—A committee consisting of H. C. Keil, J. F. Robinson and C. Mayries, Beardstown, Cass county, has been appointed to secure right of way for a highway from Beardstown to the Morgan county line.

COLORADO.—The commissioners have been discussing a plan for constructing roads from Fort Collins to North Park, and from Livermore to the Laramie River, Laramie county, and a committee, consisting of Abner Loomis, A. H. Hill and A. A. Nye, of Fort Collins, has been appointed to investigate.

IDAHO.—The state wagon road commission is considering plans for improving the road between Marysville and Wallace. The commission has appropriated $20,000 for work on the road. J. W. Birdseye, Ch. Engr., Boise City.

BRIDGES AND TUNNELS.

BROOKLINE, MASS.—The following bids were received May 22 for the superstructure of a 100-ft. iron footbridge: R. F. Hawkins, $1,894; Berlin Iron Bridge Co., $2,640; Pottsville Iron & Steel Co., $3,100; F. von Emperger, system Melan, own design, $1,900. Alexis H. French, Engr.

FREDONIA, N. Y.—The recent high water is reported to have done much damage to bridges in this town, Frewsburg, Laona, Russells, Piffard, Rushford, Wales Center, and many other places.

GETTYSBURG, PA.—Bids are asked by the county commissioners until June 12 for the construction of a 160-ft. bridge over Marsh Creek.

CLEVELAND, O.—The director of public works has been authorized to prepare plans for two new bridges.

DETROIT, MICH.—The secretary of the park commission has been directed to advertise for bids to construct several small stone bridges on Belle Isle Park.

MARENGO, WIS.—It is stated that a large number of bridges and dams on the Marengo River were carried away by the recent high water.

VICTORIA, TEX.—The county commissioners are selecting a location for a proposed bridge across the Guadalupe River, at or near Nursery.

PALMER LAKE, COLO.—A bridge on the Atchison, Topeka & Santa Fe R. R., 1½ miles east of this place, was burned May 15.

CATHLAMET, WASH.—Bids are asked until July 10 for constructing a drawbridge. O. M. Harvey, Auditor of Wahkiakum county.

WINNIPEG, MAN.—The following bids were received for constructing the superstructure of the Maryland St. bridge:

*King Bridge Co., steel and iron	$16,426
Wisconsin Bridge & Iron Co., wooden bridge	14,200
" " " " " iron	$16,000 to 17,840
W. J. Ross, wooden bridge	11,990
J. W. Buchanan, wooden bridge	11,375
Sharp, Thomson & Co., wooden bridge	12,532
Rourke & Cass, wooden bridge	10,160
Chicago Bridge & Iron Co., iron	13,994
*Dominion Bridge Co.	$12,240 and 12,600
Hamilton Bridge Co., iron bridge	15,730
**Central Bridge & Engn'ring Co., iron and steel	10,913
Gillette-Herzog Mfg. Co., iron	14,623
Detroit Bridge & Iron Wks, iron,	$14,000 to 21,000

* $500 less for a roadway of 18 ft.
** $600 less for a roadway of 18 ft.

WATER-WORKS.

GORHAM, ME.—The Gorham Water Co. is reported as taking steps toward putting in works. H. R. Millett and I. W. Dyer are interested.

UNION, ME.—The Union Water Co. is considering plans for works.

MANCHESTER, N. H.—This item last week should have read Manchester, Vt.

GROVETOWN, N. H.—Plans prepared by J. I. Williams estimate the cost of proposed works at $18,000, according to reports.

LUDLOW, VT.—Joel Foster, Montpelier, is making surveys for works.

MANCHESTER, VT.—A local company is being organized to put in works in the fall.

MORRISVILLE, VT.—The Morrisville Aqueduct Co. is about to commence work on securing an additional supply on Elmore Mountain, according to reports.

FALMOUTH HEIGHTS, MASS.—The Falmouth Heights Water Co. has been incorporated by W. P. Brooks, H. K. Craig and others.

FOXBORO, MASS.—The citizens have voted to issue $10,000 in bonds for extensions, recently authorized.

IPSWICH, MASS.—The town has been authorized to issue $30,000 additional water bonds.

MARLBORO, MASS.—The city has been authorized to issue $35,000 in bonds for increasing its supply for fire service.

MEDWAY, MASS.—The incorporators of the Medway Water Co. have elected E. V. Mitchell president and H. E. Bullard, of Holliston, treasurer.

NORTH BROOKFIELD, MASS.—N. E. Craig, Spencer, has prepared plans for about two miles of extensions. The pipe will be furnished by Chas. Millar & Son, but the contract for pipe laying has not been awarded.

ROCKPORT, MASS.—J. W. Longstreet & Co. have purchased the $100,000 of water bonds at $103,500.—The contract for a stand-pipe was awarded to Cunningham & Co., Cambridgeport, at $6,400.

SOUTH DEERFIELD, MASS.—Steps are being taken to secure works, according to reports.

WESTHAMPTON, MASS.—Plans for a supply are being considered.

WINCHENDON, MASS.—The town has been granted authority to put in works.

CROMWELL, CONN.—The Portland Water Co. is considering an extension to this place.

COLLEGE POINT, N. Y.—Bids are asked until June 4 for the sale of $11,000 in 20-year 4% water bonds. F. R. Clair, Village Treas.

DOWNSVILLE, N. Y.—The Downsville Water Co. has been incorporated and is taking steps to put in works; capital stock, $8,000; Pres., C. E. Hulbert; Secy., H. J. Williams.

DUNKIRK, N. Y.—Plans have been prepared for a reservoir to cost about $6,000 according to reports.

EARLVILLE, N. Y.—G. H. Clark, E. C. Bentley and L. S. Arnold have been appointed water commissioners, and it is stated that an election will soon be held to vote on the question of works.

HAMMONDSPORT, N. Y.—It is reported that the sentiment in favor of works is almost unanimous.

JOHNSTOWN, N. Y.—The question of an artesian supply is being investigated.

MONTICELLO, N. Y.—John A. Miller, Goshen, is preparing plans for works; supply to be from driven wells. Works will probably include a 20 × 70 ft. standpipe.

OSWEGO FALLS, N. Y.—An election has been called for May 31 to vote on a supply from the Fulton Water-Works Co.

VALATIE, N. Y.—Bids are asked until June 6 for trenching, pipelaying and carting of material for proposed works. W. H. Wild, Pres. Comrs.

JERSEY CITY, N. J.—The bids received about a year ago for a new supply were all rejected May 23.

PENNINGTON, N. J.—A company is being organized with a capital stock of $10,000 to put in works.

SPRING LAKE BEACH, N. J.—The North Spring Lake Water Co. has been incorporated to operate works in the borough of North Spring Lake; capital stock, $50,000; J. R. Fanshawe, Philadelphia; G. A. Rumsey, Salem, N. J.; C. W. Tuttle, North Spring Lake.

ALLEGHENY, PA.—The council has voted to award a contract for two iron storage tanks to Riter & Conley, Pittsburg, at $10,074.

BEAVER FALLS, PA.—Bids are asked until June 1 for sinking test wells at the mouth of Wallace Run and pumping therefrom. Engrs., Jas. H. Harlow & Co., Wilkinsburg. L. S. Lutton, Chn. Com.

DALTON, PA.—The North Abington Water Co. has been incorporated to supply this place with water; capital stock, $2,500; Treas., Willander A. Dean.

FOREST CITY, PA.—Surveys are being made for a reservoir for the Rock Cliff Water Co., according to reports.

McKEESPORT, PA.—Bids are asked until June 4 for the construction of a horizontal tubular boiler. E. Wolf, Secy. Comrs.

MIFFLINBURG, PA.—The Mifflinburg Water Co. has been incorporated; capital stock, $1,000; Treas., Dr. E. H. Leffler.

WRIGHTSVILLE, PA.—W. D. Wanner, Reading, and S. S. Detwiler, Columbia, are interested in a proposed company to put in works.

TOWSON, MD.—The Towson Water Co. is arranging to put in works, supply from an artesian well; Pres., John Hubner; Secy., Prof. Jas. E. Green.

CUTHBERT, GA.—The citizens have voted almost unanimously to issue $40,000 in bonds for water-works and $10,000 for electric lights. An engineer will soon be employed to prepare plans, after which contracts will be awarded for the construction. Robert L. Moye, Mayor.

DUBLIN, GA.—An artesian well is being sunk for a supply for works.

SAVANNAH, GA.—The Savannah Tank & Supply Co. is reported as wishing bids for a 2,500,000-gallon pumping plant. Address J. A. G. Carson.

CRESCENT CITY, FLA.—Works are being put in by Miller & Cash, according to reports.

QUINCY, FLA.—A company is being organized, with a capital stock of $10,000, to put in works.

PARIS, TENN.—The city has voted to issue $45,000 in bonds for works and an electric light plant, and O. C. Barton, Mayor, is a member of the committee to sell the bonds.

LANCASTER, KY.—The contract for the artesian well for the Lancaster Ice, Light & Water Co. has been awarded to C. A. Ray, Providence, R. I., at $4,000, and that for ice machine to the Burns Mfg. Co., Atlanta, Ga. No other contracts will be awarded until after July 1. Fred Balcom, Secy.

SHELBYVILLE, KY.—The citizens have voted, 441 to 38, to pay $4,500 per year for water and electric lights.

ASHLAND, O.—The city has been authorized to issue $45,000 in bonds for works and an election will soon be held to vote on the question.

CADIZ, O.—Bids are asked until June 25 for the purchase of $30,000 in bonds for the construction of works. W. H. Lucas, Town Clerk.

GALLIPOLIS, O.—Bids are asked until June 15 for constructing works, as stated in our advertising columns. A. D. Alcorn, Cy. Clk.

PLYMOUTH, O.—The citizens are reported as considering the question of works.

ZANESVILLE, O.—A press report states that a standpipe will be erected.

GRAND RAPIDS, MICH.—The board of public works is considering the question of a new 16-in. main, estimated to cost $25,000 or $30,000.

THOMPSONVILLE, MICH.—It is stated that a contract has been awarded for the sinking of three artesian wells for works.

BELLEVILLE, ILL.—Plans for a new reservoir to cover 31 acres have been made by Gustave Hillyard, according to reports.

DUNDEE, ILL.—It is reported that surveys for works will be made at once.

EVANSTON, ILL.—The Seckner Contracting Co., Unity Bldg., Chicago, has been awarded the contract for laying water mains in the German Addition to Evanston.

FARMINGTON, ILL.—Bids are asked until June 25 for constructing works, as stated in our advertising columns. Engr., Chas. F. Sturtevant, St. Louis. A. Clark, Cy. Clk.

KENOSHA, WIS.—Dr. Hazleton is interested in a company that is reported as planning to put in works.

MINOCQUA, WIS.—The contract for works is reported to have been awarded to J. E. Jackson, Rhinelander, at $4,200.

KINGSLEY, IA.—Bids are asked until June 6 for the construction of works. J. A. Ingalls, Cy. Recdr.

RED OAK, IA.—The contract for constructing the proposed works has been awarded to J. L. Black, 422 Bee Bldg., Omaha, Neb., at $11,187. The Fremont Foundry & Machine Co. bid $11,300 for the work complete; H. Palmer, Red Oak, $15,250; E. A. Rudiger, Nebraska City, Neb., $12,724. The bids for the 20 × 100 ft. stand-pipe were: Fremont Foundry & Machine Co., $4,690; Dan. Green, Red Oak, $4,911; Geo. E. King Bridge Co., Des Moines, $5,418; Tippett & Wood, Phillipsburg, N. J., $5,104; Claywood & Ritter, Chicago, $5,450; King Bridge Co., Cleveland, O., $4,750. Engr., F. L. Burrell, Fremont, Neb. R. O. Newell, Cy. Clk.

SHELDON, IA.—A new election resulted in a majority of 200 in favor of works, and the contract has been awarded to H. C. Wheeler, Beloit, Wis., according to reports.

ADRIAN, MINN.—The contract for works and an electric light plant has been awarded to Sykes & Wagner, Minneapolis, at $18,000.

MINNEAPOLIS, MINN.—It is stated that the construction of the proposed submerged main at 32d Ave. will be commenced at once.

PARK RAPIDS, MINN.—The contract for works has been awarded to Fairbanks, Morse & Co., at $5,000.

WINNEBAGO CITY, MINN.—Bids are asked until June 16 for the purchase of $5,000 of 20-year 6% bonds. J. H. Sherin, Cy. Recdr.

WINFIELD, KAN.—The pumping station is reported to have been burned May 17, causing a loss of $3,000.

FREMONT, NEB.—Bids are asked until June 11 for 5,693 ft. of 6-in. and 1,654 ft. of 4-in. pipe, one vacuum pump, three or more tubular wells 75 ft. deep, 12 hydrants, etc. F. L. Burrell, Engr.

HEBRON, NEB.—Bids are asked until June 4 for 1,620 ft. of 40-lb. 8-in. pipe. F. D. Church, Cy. Clk.

SOUTH OMAHA, NEB.—The council has passed an ordinance granting a franchise to John A. McShane for works estimated to cost $250,000 for the stock yards district. The works are expected to be completed this year.

SPRINGFIELD, NEB.—M. G. Nicholson is a member of a committee appointed to get estimates for works.

STERLING, NEB.—A committee has been appointed to investigate the question of works.

STRATTON, NEB.—An election will be held June 12 to vote on the question of works, for which plans are being prepared by A. A. Richardson, Lincoln.

CENTREVILLE, S. DAK.—Bids are asked until July 2 for constructing works. Engr., A. A. Richardson, Lincoln, Neb.

BETHANY, MO.—It is stated that $30,000 of bonds have been sold for works and an electric light plant, and that specifications are being made for the construction.

GLASGOW, MO.—The contract for works is reported to have been awarded to A. W. Eisner, Jefferson City, and F. W. Raeder, St. Louis.

RICHMOND, MO.—The citizens are reported as wanting works.

FAYETTEVILLE, ARK.—Efforts are being made to secure works, according to reports.

BOWIE, TEX.—The city is reported as having contracted for works, the construction to be commenced within 30 days; the contract calling for a standpipe, 18,000 ft. of mains and an annual rental of $35 per year for each hydrant in excess of 25. The contractor will also put in an ice plant and electric light plant.

HEMPSTEAD, TEX.—A 50-year franchise has been granted to the Hempstead Water-Works Co. It is stated that the construction of the works will be commenced at once.

HOUSTON, TEX.—Bids are asked until June 11 for supplying the city with water for one year. John T. Browne, Mayor.

GUTHRIE, OKLA.—Press reports state that the town of Blackwell, in the Cherokee strip, has voted to issue $35,000 in bonds for works.

ELGIN, ORE.—The citizens have voted to issue $8,000 in bonds for works.

FORT WILLIAM, ONT.—The town wishes to negotiate with a company for works. Address the town clerk.

YARMOUTH, N. S.—Bids are asked by the council until June 4 for pumps and other electric outfit for the proposed electric pumping station at Milton Pond.

ARTESIAN WELLS.

MEDFORD, ORE.—The council has contracted with L. P. Denny, Gridley, Cal., to bore an artesian well 500 ft. deep for $3,000, and $7.50 per ft. beyond 500 ft.

IRRIGATION.

DENVER, COLO.—The High Line Reservoir Co. has increased its capital stock from $150,000 to $300,000 to construct a reservoir in South Park, in townships 12 and 13, Park county.

NEW COMPANIES.—Beaver Creek, Altman & Victor Reservoir & Pipe Line Co., Denver, Colo.; $100,000; David McShane, J. C. Woodbury, C. E. Stubbs.——Kitchen Irrigation & Mfg. Co., Menard county, Tex.; $2,000; T. M. Kitchen, J. L. Alexander, Wm. Stenzle.

SEWERS.

CONCORD, N. H.—Bids are asked until June 7 for laying 15 to 10-in. sewers, as stated in our advertising columns. W. B. Howe, Cy. Engr.

LUDLOW, VT.—Joel Foster, Montpelier, has been engaged to prepare plans for a system.

ATHOL, MASS.—A committee consisting of E. V. Wilson, O. T. Brooks and O. A. Fay has been appointed to secure plans for a system.

WOBURN, MASS.—The council has requested the finance committee to recommend an appropriation of $50,000 for sewers.

NEW HAVEN, CONN.—Bids are asked by the council until June 5 for the sale of $100,000 of 4% sewerage bonds.

BROOKLYN, N. Y.—Robert Van Buren has been engaged to make an examination of the present system of sewerage in the old towns of Flatbush, Gravesend, New Utrecht and Flatlands, and if necessary to present a plan by which those sections of the city may be well drained.

FORT EDWARD, N. Y.—Plans for a system have been prepared by Palmer H. Baermann, Troy.

TROY, N. Y.—Bids are asked by the board of contract until June 8 for constructing a sewer in Maple Ave.

PITTSTON, PA.—Potter & Folwell, Pittsburg, have been engaged to make surveys and plans for a sewerage system in West Pittston.

MILLSBORO, DEL.—It is reported that a system will be constructed.

PORTSMOUTH, VA.—Bids are asked until June 23 for constructing 650 lin. ft. of 18-in. cast iron pipe sewer, 80,805 lin. ft. of 18 to 8-in. pipe sewer, 124 flush tanks, and 109 manholes, as stated in our advertising columns. This city being not more than 12 ft. above low tide at its highest point, pumping will be necessary, and Shone ejectors will be used at several points. W. T. Brooke, Cy. Engr., Norfolk, is engineer of the work.

ALLIANCE, O.—Bids are asked until June 2 for constructing 6,120 lin. ft. of 12 to 6-in. sewers. Thos. Casselman, Cy. Clk.

HAMILTON, O.—L. A. Dillon has been appointed engineer for the construction of the proposed system.——The council has decided to issue $90,000 of 15-year sewerage bonds.

SANDUSKY, O.—Bids are asked until June 9 for constructing a sewer in North Depot St. A. W. Miller, Cy. Clk.

INDIANAPOLIS, IND.—The board of public works has voted to construct a sewer 4,330 ft. in length.

CHICAGO, ILL.—Bids are asked until June 5 for constructing sewers in 15 streets. H. J. Jones, Comr. Pub. Wks.

LITCHFIELD, ILL.—The council has ordered extensions in two streets.

DOWAGIAC, MICH.—Bids are asked for making surveys for a sewerage system. Hl. Arthur, Cy. Clk.

NEENAH, WIS.—It is reported probable that the plans for the proposed system will soon be completed.

DENVER, COLO.—The board of public works has decided to extend the sewer in Delgany St. to 31st St.

EUREKA, CAL.—J. W. Lentell, Cy. Engr., and W. F. Boardman, Consult. Engr., have reported that the proposed system would cost $80,000.

LOS ANGELES, CAL.—The city engineer has made plans for constructing 11 miles of 12 to 8-in. sewers, estimated to cost about $45,000.

SALT LAKE CITY, UTAH.—The council has ordered the completion of the gravity sewer.

WALLACE, IDAHO.—Bids are asked until July 1 for the purchase of $10,000 in sewer and street improvement bonds. A. E. Angel, Cy. Clk.

MONTREAL, QUE.—Contracts for constructing sewers have been awarded to O. Durocher, Murray Bros., W. Stevenson, Chartier & Robert M. Gosselin, and the Standard Drain & Pipe Co.

STREETS.

BROOKLINE, MASS.—A town meeting will be held May 28 to vote on issuing $131,000 in bonds for widening and improving two streets.

BROOKLYN, N. Y.—Bids are asked until June 11 for paving Pacific Ave. with cobblestones. A. T. White, Comr. Cy. Wks.——The sum of $250,000 has been appropriated to begin work on the proposed shore road. E. R. Kennedy, J. B. Woodward and William Brown are commissioners.

BUFFALO, N. Y.—Bids are asked until June 6 for paving five streets with asphalt, brick or granite. R. G. Parsons, Acting Secy., Dept. Pub. Wks.——The board of public works has received the following bids for paving Victoria, Wakefield, and Rodney Aves., respectively:

W. E. Hingston, brick	$17,025	$16,375	$23,092
German Rock Asphalt Co.	21,530	20,150	30,122
P. B. McNaughton, brick	14,990	14,678	21,500
Barber Asphalt Paving Co.	20,693	19,853	28,916

ITHACA, N. Y.—The council has voted to spend $10,000 for paving. H. A. St. John, Supt. Comrs.

NEW YORK, N. Y.—Bids are asked by the department of docks until June 7 for 3,908 sq. yds. of granite paving, 1,544 sq. ft. of crosswalk, etc.——Bids are asked by the department of public works until June 11 for paving six streets with asphalt and three with granite.

SYRACUSE, N. Y.—Plans are being prepared for paving with brick and Trinidad Lake asphalt.

TROY, N. Y.—Bids are asked by the contracting board until June 8 for paving Second St. with granite and Maple Ave. with asphalt.

MONTCLAIR, N. J.—Bids for constructing 6 and 8-in. macadam roads during the ensuing year are wanted by the town council until June 11; also until the same date for flag and cross walks. H. Trippett, Clk.

NEW ORLEANS, LA.—The council is discussing the paving of 19 streets with either brick, gravel or asphalt.

LOUISVILLE, KY.—Bids are asked by the board of public works until June 6 for grading, curbing and paving 15 streets with brick.

BOND HILL, O.—Bids are asked until June 4 for improving Oakland Ave. W. H. Brickel, Jr., Village Clk.

MARION, O.—A committee is investigating the question of paving the streets with brick. T. C. Bowen, Cy. Engr.

NORWOOD, O.—Bids are asked until June 16 for grading and macadamizing two streets. Engr., J. M. Harper, Cincinnati.

PIQUA, O.—The city has been authorized to spend $150,000 for paving.

TIFFIN, O.—About 70,000 sq. yds. are to be paved this season with brick or granite. C. J. Peters, Cy. Engr.

BRAZIL, IND.—Bids are asked until June 5 for grading and macadamizing Jones St. John Macdonald, Cy. Clk.

EVANSVILLE, IND.—The council is discussing paving 21 alleys with brick.

DETROIT, MICH.—The park and boulevard commission has awarded contracts for paving the boulevard as follows: Section 8, F. J. Kennedy, limestone macadam, at $7,365; sections 9 and 10, Michigan Stone & Supply Co., limestone macadam, at $4,003 and $16,226.

CHICAGO, ILL.—Bids are asked, until June 4 for laying stone and cement sidewalks in 25 streets and for improving 16 streets.

VISALIA, CAL.—Efforts are being made to pave Main St. with asphalt.

HAMILTON, ONT.—The council has ordered an election on June 26 to vote on an appropriation of $150,000 for paving King and James Sts. with Trinidad Lake asphalt.

ELECTRIC LIGHT AND POWER.

READING, MASS.—The town has voted to put in an electric light plant. A committee has reported that a 90 × 45-ft. brick power station with machinery and 41 miles of wire, could be constructed at a cost of $41,000.

SPRINGVILLE, N. Y.—A storage reservoir covering 17 acres is to be constructed for the purpose of supplying this place with power for manufactories and an electric plant. Messrs. King, of Delevan, and Scott, of this place, are reported as in charge of the enterprise.

DARBY, PA.—Bids are asked until June 4 for lighting the streets. G. T. Smith, Chn. Com.

WASHINGTON, D. C.—Bids are asked until June 15 for an electric light plant for the U. S. Marine Hospital, at Portland, Me., as stated in our advertising columns. Jeremiah O'Rourke, Supervising Architect.

CUTHBERT, GA.—Robt. L. Moye, Mayor, writes us that an engineer will soon be employed to prepare plans for an electric light and water-works plant, for which $50,000 in bonds has been voted.

CLARKSVILLE, TENN.—The Clarksville Electric Light Co. has been organized by E. B. Tyler, John F. McDermont and others. The present plant will be purchased and $10,000 will be spent in new machinery, according to reports.

OVID, MICH.—W. R. Shaw, Pres., writes us that the contracts for an electric light plant has been awarded as follows: Construction and one 30-light arc dynamo and one 750-light alternator to the Commercial Electric Engineering Co., Detroit, at $6,208; one 60-in. × 16-ft. boiler and one 100-HP., four-valve engine, to Arbuckel, Ryan & Co., Toledo, O., at $3,178.

HOUSTON, TEX.—Bids are asked until June 11 for street lighting for one year. John T. Browne, Mayor.

NEW COMPANIES.—Western Electric Accumulator Co., St. Louis, Mo.; $10,000; Joseph Kings, Emil Braun, P. H. Bierman.——Bucksport Light & Power Co., Bucksport, Me.; $10,000; Pres., Parker Spofford; Treas., E. B. Gardiner.——Waterport Electric Light & Power Co., Waterport, N. Y.; $40,000; Daniel G. Bromley, Waterport; Lina Beecher, Chas. Beaver, Batavia.——Poppowitsch Electric Co., Jersey City, N. J.; $100,000;

Edward Poppowitsch, Gustav Lock, Chas. F. Rockstroh, Brooklyn, N. Y.——Fort Wayne Electric Mfg. Co., Fort Wayne, Ind.; $10,000; Fred Eckart, Sr., Wm. Orr, Henry Orr.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

ELECTRIC WIRING.—Canton, O.—Bids are asked until June 5 for the electric wiring of the Stark county court house. L. A. Loichot, Clk.

PIERS.—New York, N. Y.—The department of docks has voted to advertise for bids for a steel and a wooden pier between 60th and 64th Sts.

PARK IMPROVEMENTS.—Cleveland, O.—Bids are asked until June 6 for grading, draining and improving Perkins Park. C. W. Pratt, Jr., Ch. Engr., Park Comrs.

BUILDING.—Milledgeville, Ga.—Bids are asked until July 10 for the complete erection of a brick building, three stories in height, to cost not exceeding $100,000, for the Georgia state lunatic asylum. Archs., W. Chamberlain & Co., Knoxville, Tenn. G. A. Cabaniss, Pres. Bd.

ELECTRIC CRANE.—Philadelphia, Pa.—Jas. H. Windrim, Dir. Dept. Pub. Wks., writes us that the contract for an electric travelling crane has been awarded to Wm. Sellers & Co., 1,600 Hamilton St., at $7,435, the only other bid being that of the Yale & Town Mfg. Co., 1,120 Market St., at $7,750 and $8,600, both bidders of Philadelphia.

PUMPING PLANT.—Sacramento, Cal.—Bids are asked until June 4 for plans, specifications and estimates for building a pumping plant of sufficient capacity to free the upper part of Andrus Island, Sacramento county, from the natural accumulation of water. P. H. McGrath, Secy. Trustees Reclamation Dist. No. 556.

DREDGING.—Oakland, Cal.—The city engineer has been directed to prepare plans for dredging at the city wharf.

New York, N. Y.—The department of docks will soon ask for bids for a large amount of dredging in the North River, according to reports.

Portland, Me.—Bids are asked until June 16 for dredging in Saco River, as stated in our advertising columns. Lieut.-Col. Peter C. Hains, U. S. A.

Baltimore, Md.—Bids are asked until June 7 for dredging about 185,000 cu. yds. N. H. Hutton, Engr., Harbor Bd.

CONDENSED LIST OF CONTRACTS PENDING, WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
June 1.	Electric lighting, Jackson, Tenn.		April 26
June 1.	Sewer (9,500 lin.ft.), Advertised, Eng. News, May 17 and 24.	Frankfort, Ind.	May 10
June 1.	Elevator, Gov't Bldg., Advertised, Eng. News, May 10 and 17.	Galveston, Tex.	
June 1.	W.-w'ks bonds, E. Cottage Grove, Ore.		May 10
June 1.	Granite block paving, Brooklyn, N. Y.		May 24
June 1.	Pipe sewers, Rochester, N. Y.		May 24
June 1.	Pipelaying, Tarrytown, N. Y.		May 24
June 1.	Water service pipes, Chicago, Ill.		May 24
June 1.	Wells, Beaver Falls, Pa.		May 31
June 2.	Elec. l't and p'p'g pl't,	Newberry, Mich.	May 10
June 2.	Iron h'way bridge,	Kansas City, Kan.	May 17
June 2.	Water-whl. and pump, Advertised, Eng. News, May 17 and 24.	Freehold, N.J.	May 17
June 2.	Water-works, Columbia City, Ind. Advertised, Eng. News, May 24 and 31.		May 24
June 2.	Brick paving, Cincinnati, O.		May 24
June 2.	Brick paving, Belleville, Ill. Advertised, Eng. News, May 24.		May 24
June 2.	Brick paving, Davenport, Ia.		May 24
June 2.	Sewer, Davenport, Ia.		May 24
June 2.	Brick paving, Des Moines, Ia.		May 24
June 2.	Fire hydrants (50), Des Moines, Ia.		May 24
June 2.	River deepening, London, Ont.		May 24
June 2.	Sewers, Alliance, O.		May 31
June 4.	Bridges, dat'g '94, Fort. Madison, Ia.		May 3
June 4.	Bridge, Vicksburg, Miss.		May 24
June 4.	Grading, Bond Hill, O.		May 24
June 4.	Paving, Dayton, O.		May 24
June 4.	Highways, Boston, Mass.		May 31
June 4.	Water bonds, College Point, N. Y.		May 31
June 4.	Street lighting, Darby, Pa.		May 31
June 4.	Roller, McKeesport, Pa.		May 31
June 4.	Street improvements, Bond Hill, O.		May 31
June 4.	Street improvements, Chicago, Ill.		May 31
June 4.	Pipe, Hebron, Neb.		May 31
June 4.	Electric pumps, Yarmouth, N. S.		May 31
June 5.	Government bldg., Haverhill, Mass. Advertised, Eng. News, May 10 and 17.		
June 6.	Iron wk., etc., Univ. bldg.,	Cincinnati, O.	May 10
June 5.	Supplies, War Dept., Washington, D.C. Advertised, Eng. News, May 17.		
June 5.	Water-w'ks system,	Hutchinson, Minn.	May 17
June 5.	Irrigation bonds,	Ellensburg, Wash.	May 17
June 5.	Pipelaying (17 miles),	Lowville, N. Y.	May 24
June 5.	Brick paving,	Fostoria, O.	May 24
June 5.	Sewers,	Terre Haute, Ind.	May 24
June 5.	Macadamizing,	St. Louis, Mo.	May 24
June 5.	Sewer bonds,	New Haven, Conn.	May 31
June 5.	Electric wiring,	Canton, O.	May 31
June 5.	Macadamizing,	Brazil, Ind.	May 31
June 5.	Sewers,	Chicago, Ill.	May 31
June 6.	Water-works system, Advertised, Eng. News, May 17.	Penn Yan, N.Y.	May 17
June 6.	Paving (5 streets),	Buffalo, N. Y.	May 31
June 6.	Pipelaying, etc.,	Valatie, N. Y.	May 31
June 6.	Brick paving,	Louisville, Ky.	May 31
June 6.	Water-works system,	Kinsley, Ia.	May 31
June 6.	Park improvements,	Cleveland, O.	May 31
June 7.	Relaying St.Ry.track,	Washington, D.C.	May 24
June 7.	Sewers, Advertised, Eng. News, May 31.	Concord, N. H.	May 31
June 7.	Paving,	New York, N. Y.	May 31
June 7.	Dredging,	Baltimore, Md.	May 31
June 8.	Water-works system, Advertised, Eng. News, May 3 to 24.	Danville, Ky.	May 24
June 8.	Sewers,	Troy, N. Y.	May 31
June 8.	Granite paving,	Troy, N. Y.	May 31
June 9.	Water-w'ks and sewers,	Helena, Mont.	May 24
June 9.	Water-works bonds,	Pender, Neb.	May 24
June 9.	Sewers,	Sandusky, O.	May 31
June 11.	Ft. Harrison, U.S.A.,	Helena, Mont.	May 17
June 11.	Paving, Advertised, Eng. News, May 24 and 31.	Gloversville, N. Y.	May 24
June 11.	Grading, Bond Hill, O.		May 24
June 11.	Cobblestone paving,	Brooklyn, N. Y.	May 31
June 11.	Paving,	New York, N. Y.	May 31
June 11.	Macadamizing,	Montclair, N. J.	May 31
June 11.	Pipe, wells, etc.,	Fremont, Neb.	May 31
June 11.	Water supply (1 year),	Houston, Tex.	May 31
June 11.	Street lighting,	Houston, Tex.	May 31
June 12.	Asphalt paving,	Schenectady, N. Y.	May 10
June 12.	Street improvements,	Cincinnati, O.	May 24
June 12.	Street improvem'ts (22),	St. Louis, Mo.	May 24
June 12.	Water-works system, Advertised, Eng. News, May 24.	Brunswick, Mo.	May 24
June 12.	Electric light plant, Advertised, Eng. News, May 24.	Brunswick, Mo.	May 24
June 12.	Bridge,	Gettysburg, Pa.	May 31
June 13.	Iron bridge spans, Advertised, Eng. News, May 3 to June 7.	Hawkinsville, Ga.	May 3
June 13.	Sewers,	Cleveland, O.	May 24
June 13.	Fireboat,	Cleveland, O.	May 24
June 14.	Water-works system, Advertised, Eng. News, May 17 and 24.	Norfolk, Conn.	May 17
June 14.	Sewer plans,	Sacramento, Cal.	May 24
June 15.	El.lt.plt., U.S.M.Hosp., Advertised, Eng. News, May 31, June 7.	Portland, Ore.	May 31
June 15.	Water-works, Advertised, Eng. News, May 31, June 7.	Gallipolis, O.	May 31
June 16.	Water tank,	Fort Monroe, Va.	May 24
June 16.	Bonds,	Faribault, Minn.	May 24
June 16.	Dredging, Advertised, Eng. News, May 31 to June 14.	Portland, Me.	May 31
June 16.	Highway,	Mount Cory, O.	May 31
June 16.	Macadamizing,	Norwood, O.	May 31
June 16.	Water bonds,	Winnebago City, Minn.	May 31
June 18.	Highway,	Little Rock, Ark.	May 17
June 19.	Alley improvem'ts (24),	St. Louis, Mo.	May 24
June 20.	Railway excavation, Advertised, Eng. News, May 24 to June 14.	Evansville, Ind.	May 24
June 20.	Lining tunnel, Advertised, Eng. News, May 24 to June 14.	Evansville, Ind.	May 24
June 20.	Reservoir,	Lowville, N. Y.	May 24
June 23.	Sewers, Advertised, Eng. News, May 31, June 7.	Portsmouth, Va.	May 31
June 25.	Water-works bonds,	Cadiz, O.	May 31
June 25.	Water-works system, Advertised, Eng. News, May 17 to 31.	Farmington, Ill.	May 17
June 26.	Water-works bonds,	Danville, Ky.	May 17
July 1.	Sewer bonds,	Wallace, Idaho.	May 31
July 2.	Water-w'ks system,	Centreville, S.Dak.	May 31
July 3.	Pipe,	Victoria, B. C.	May 24
July 10.	Bridge,	Cathlamet, Wash.	May 31
———	Water-works franchise, Advertised, Eng. News, May 10 to 31.	Florence, N.C.	May 10
———	Water-works system,	Ipswich, Mass.	May 24
———	Bridge,	Natchez, Miss.	May 24
———	W.-w. franchise,	Ft. William, Ont.	May 31
———	Sewer plans,	Dowagiac, Mich.	May 31

CONTRACT PRICES.

PIPE.—Philadelphia, Pa.—Jas. H. Windrim, Dir. Dept. Pub. Wks., writes us that the contract for a supply of 48-in. cast iron water pipe has been awarded to the McNeal Pipe & Foundry Co., at $17.80 per ton, with special castings at 2 cts. per lb. The Reading Foundry Co. bid $18.20 and 2 cts.; Howard-Harrison Iron Co., $20 and 2 cts.; Camden Iron Co., $18.60 and 2½ cts..

Rockport, Mass.—The contract for pipe for the proposed water-works has been awarded to R. D. Wood & Co., at $21.35 per gross ton delivered at wharf in this city. Engrs., E. Worthington & Co., Boston.

St. Bernard, O.—Geo. Hornung, Consult. Engr., Cincinnati, writes us that the following bids have been received for 680 tons of 10 to 4-in. cast iron pipe, and 61 tons of special castings, the bid being per ton:

	Pipe.	Special.
Radford Pipe & F'ndry Co., Radford, Va.	$18.95	$40.00
C. W. Harrison, Agent, Chicago	18.20	45.00
Nat'l Foundry & Pipe Wks., Scotdale, Pa.	17.70	42.50
Addyston Pipe & Steel Co., Cincinnati	17.50	43.00
S. Pittsburg Pipe Wks., S. Pittsb'g, Tenn.	17.35	40.00
Anniston Pipe & F'ndry Co., Anniston, Ala.	16.95	42.50

Cleveland, O.—Bids were opened May 17 for about 1 ton of 3-in. pipe, 25 tons of 4-in., 1,000 tons of 6-in., 500 tons of 8-in., 200 tons of 10-in., 800 tons of 12-in., 500 tons of 16-in., 7 tons of 24-in., 10 tons of 30-in., and 900 tons of 36-in. pipe. The bids were as follows: Lake Shore Foundry, 3-in. pipe, $18.50; 4-in., $18.25; 6-in., $18; 8 to 48-in., $17.95. Anniston Pipe & Foundry Co., 3 to 48-in., $18.10; Howard-Harrison Iron Co., 3 to 48-in., excepting 20-in., $18.10; J. B. Clow & Son, 6 and 8-in., $16.50, 12 to 36-in., $14.75. Last year it is stated that the Lake Shore Foundry bid $21.40 and the year before $24.10. This work was advertised in February, and the lowest bid was that of Jas. B. Clow & Son, at $17.50 to $19.50, and since that time the director of public works has been purchasing pipe, $500 worth at a time, at $17.25 per ton.

PIPELAYING.—Milwaukee, Wis.—The contract for laying water mains for the fire department during the present year has been awarded to R. J. Hickey, at 28 cts. per lin. ft. for 10-in. pipe and 23 cts. for 8-in.

STEEL PIPE.—Milwaukee, Wis.—G. H. Benzenberg, Cy. Engr., writes us that the following bids were received May 18 for 13,500 ft. of 2-in. and 10,000 ft. of 2½-in. standard weight steel pipe for putting fire department wires underground, the price being given per lineal foot:

	2-in.	2½-in.
H. Mooers Co., Milwaukee	7.9 cts.	11.4 cts.
Rundle-Spence Mfg. Co., Milwke.	7.5* "	11. "
Hoffman Mfg. Co., Milwaukee	8.5 "	11¼ "
J. B. Clow & Son, Chicago	7.9 "	10.2* "

* Awarded contract.

WATER-WORKS SUPPLIES.—Kingston, Ont.—The water-works committee has awarded the following contracts: Pipe, St. Lawrence Foundry Co., Toronto, at $30.75 per ton of 2,000 lbs. f. o. b. cars in Kingston; lead pipe, T. Robertson, Montreal, 7 cts. per lb., less 35%, 10% and 3%; stop-cocks, R. Mitchell, Montreal, at 45 cts. for ⅝-in., and 58 cts. for ¾-in.; tarred packing, W. B. Ferguson, at 8½ cts. per lb.

WELLS.—McKeesport, Pa.—Emanuel Wolf, Secy., writes us that a contract for drilling one or more, probably ten, wells has been awarded to A. L. Wasson at 95 cts., $1.40 and $1.90 per ft., respectively, for 6-in., 8-in., and 10-in., wells with galvanized casings, and 85 cts., $1.10 and $1.40, respectively, for black casings.

ASPHALT BLOCK AND BRICK PAVING.—Middletown, N. Y.—E. M. Hamilton, Cy. Clk., writes us that the contract for 2,800 sq. yds. of paving with asphalt blocks on 6 ins. of concrete has been awarded to E. A. Brown, Middletown, at $3.05 per sq. yd., and that for 3,600 sq. yds. of paving with one course of Mack brick on 6 ins. of concrete to Orr Bros. Allegheny, Pa., at $2.35 per sq. yd., including excavation.

BRICK PAVING.—Jacksonville, Fla.—The following bids were opened May 17 for paving 15,690 sq. yds. in Main St.: Tennessee Paving Brick Co., $1.60 per sq. yd. for the work complete; for furnishing the large Robbins' brick at the works 65 cts., at Jacksonville $1.09; small Robbins' paver 55 cts. at works, and 99 cts. at Jacksonville; Hallwood patent paver 69 cts. at works, and $1.13 at Jacksonville. W. B. Harris & Co., Zanesville, O., furnishing the brick at the works 59 cts., delivered at Jacksonville $1.56. John W. Sibley, agent for the Coaldale Brick & Tile Co., Coaldale, Ala., furnishing Coaldale brick at Coaldale, 62 cts. to 86 cts. per sq. yd.; at Jacksonville, 90 cts. to $1.20. A. M. Smith, 945 Oak St., Jacksonville, for the work complete, $1.27 to $1.47 for Coaldale brick. Press reports state that the first brick paving in the city cost $2.40 per sq. yd. and a contract for paving with Robbins' brick was recently awarded at $1.89 per sq. yd., as stated in our issue of May 3.

BRIDGES.—Washington, D. C.—We are informed that the following bids were received May 23 for constructing a steel plate girder highway bridge over the James' Creek Canal at N St., the price being given in cents per pound:

R. H. Hood, Washington, D. C., (awarded contract)	2.28
Youngstown Bridge Co., Youngstown, O.	2.36
Shiffler Bridge Co., Pittsburg, Pa.	2.45
Penn Bridge Co., Beaver Falls, Pa.	2.58
Toledo Bridge Co., Toledo, O.	2.70
King Bridge Co., Cleveland, O.	2.80
Berlin Bridge Co., East Berlin, Conn.	2.90
Nelson & Buchanan, Chambersburg, Pa.	3.00
Average bid.	2.64

Cincinnati, O.—The Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. has awarded the contract for the iron bridges to be erected the present year to the Union Bridge Co., the lowest bidder. There were 18 bids received, the prices ranging from 1.9 to 2.4 cts. for deck plate girders and 1.96 to 2.4 cts. for through plate girders, f. o. b. cars; the railway company to erect them.

METAL MARKET PRICES.

LEAD.—New York: 3.3 to 3.35 cts. Chicago: 3.2 to 3.25 cts. St. Louis: 3.15 cts.

NAILS.—Pittsburg: $1.05 for wire, and 95 cts. to $1 for cut at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13. Pittsburg: $9.75 to $11.25. Chicago: $10 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.35 to 1.4 cts.; spikes 1.6 to 1.7 cts.; track bolts, 2.15 to 2.25 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $11 for iron, and $9 for steel; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10 for iron and $9.50 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.3 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.15 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.4 cts. for shell, 1.55 to 1.6 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.15 to 1.2 cts.; tees, 1.25 to 1.35 cts.; universal mill plates, 1.15 to 1.2 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.4 cts. for shell, 1.4 to 1.5 cts. for flange, 1.75 to 4 cts. for firebox. Chicago: beams, 1.45 cts.; channels, 1.45 cts.; angles, 1.4 cts.; tees, 1.6 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.5 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 2.5 to 5 cts. for firebox.

INDUSTRIAL NOTES.

LOCOMOTIVE.—A tank or tender engine of 3 ft. gage, with cylinders 8 × 12 or 9 × 14 ins., is wanted by the Cameron & Barkley Co., of Charleston, S. C.

THE BOSTON BRIDGE WORKS, Boston, Mass., have completed four bridges for the Maine Central R. R. and are building six for the Boston & Albany R. R.

H. B. HAWKINS & CO., New York, agents for the Anniston Pipe & Foundry Co., have contracts for about 600 tons of pipe for Newport, Me., and 300 tons for Woodbury, Conn.

THE COLUMBIAN EXPOSITION SALVAGE CO., of Chicago, has purchased the following buildings at Jackson Park: Manufactures, Machinery, Agricultural, Administration, Mines, Electricity, Transportation, United States Government, Horticultural, Woman's, Fisheries, Anthropological, Shoe and Leather, Dairy, Colonnade, Stock Pavilion, Choral Hall, Terminal Station and Saw Mill. All these buildings are to be wrecked, and the iron, lumber, glass and other materials in them are now being offered for sale, as noted in our advertising pages. The company's general offices are in the Administration Building, Jackson Park, Chicago.

NEW COMPANIES.—Woodlawn Portland Cement Co., Chicago, Ill.; $10,000; E. D. Culver, G. D. Green and W. Brose.——Western Electric Accumulator Co., St. Louis, Mo.; $10,000; Herman Mensendick, Joseph Furtx and Emil Brown.——Randolph Coke & Coal Co., Jersey City, N. J.; $500,000; E. E. Stockton, Bayonne, N. J.——Everson Compound Tube Co., Pittsburg, Pa.; $1,000; Treas., David Stewart.——Doylestown Gas Co., Doylestown, Pa.; $20,000; Treas., John Yardley.——Penn Engineering Co., Fernwood, Pa.; boilers and heating apparatus; $30,000; Treas., Warren M. Riegel.——Kittanning Iron & Steel Co., Kittanning, Pa.; $350,000; Treas., Henry A. Colwell.——Electro-Chemical Reduction Co., Camden, N. J.; $50,000; W. J. Cheyney, Absecom, N. J.; A. L. Eltonhead, Philadelphia, Pa.——Aiaite Aluminum Co., Montclair, N. J.; $500,000; F. M. Wheeler, Montclair, N. J.; S. H. Guggenheimer, New York.——Charles T. Porter Steam Engine Co., West Hoboken, N. J.; $2,000; Chas. T. Porter, Montclair, N. J.——Scranton Vitrified Brick & Tile Mfg. Co., Scranton, Pa.; $35,000; Treas., Arthur D. Dean.——Western Mining & Development Co., Jersey City, N. J.; mining at Aspen, Colo.; $100,000 all paid up; J. Hobart Herrick, New York; Jas. L. Tilton, Red Bank, N. J.——Kootenay Mining & Smelting Co., Jersey City, N. J.; $2,500,000, commencing with $2,000,000; E. N. Peck, New Haven, Conn.; E. H. Herrick, Minneapolis, Minn.